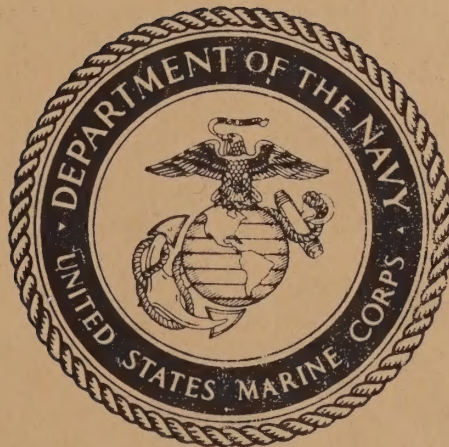


**TM 00052A-35**

**U.S. MARINE CORPS TECHNICAL MANUAL**

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**SERVICEABILITY TESTS AND ALIGNMENT  
PROCEDURES FOR RADIO SETS,  
AN/GRC-47, AN/GRC-48, & AN/MRC-40**



---

**MAY 1961**



U. S. MARINE CORPS TECHNICAL MANUAL  
SERVICEABILITY TESTS AND ALIGNMENT PROCEDURES  
for  
RADIO SETS AN/GRC-27, AN/GRC-48, AND AN/MRC-40  
TM 00052A-35  
CHANGE 1

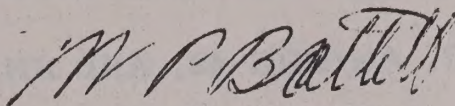
Department of the Navy  
Headquarters, U. S. Marine Corps  
Washington 25, D. C.

16 October 1962

1. This Change is effective upon receipt.
2. The following items are in error and should be changed as follows:
  - a. Reference to "Radio Set AN/GRC-47" in the title and in the letter of promulgation should be changed to read "AN/GRC-27".
  - b. Reference to "Signal Generator AN/URM-25()" on pages 2-1, 2-3, 2-6, 2-8, 2-14, and 2-36 should be changed to read "Signal Generator AN/URM-26". The frequencies prescribed are outside the range of the AN/URM-25 (10 kc to 50 mc), but within the range of the AN/URM-26 (4-408 mc).
  - c. Power amplifier procedure, section 3-11, paragraph C, step (11), on page 3-44, should read: "Manually adjust the gear train for minimum panel meter indication....".
  - d. Step (14) on page 3-44 should read: "....adjust C-611 for a minimum panel meter indication....".
  - e. Step (16) on page 3-44 should read: "....adjust C610 and C-611 for minimum reading."

3. Enter this Change on the Record of Corrections Made, in the front of the book.

By direction of the Commandant of the Marine Corps



W. P. BATTELL

Major General, U. S. Marine Corps

Assistant Quartermaster General of the Marine Corps

DISTRIBUTION: "AG" Plus: 2085/2112/2116  
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(2)  
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STANDARD REQUISITION INSTRUCTIONS FOR PUBLICATIONS

- Ref: (a) MCO P5600.31, Marine Corps Publications and Printing Regulations (less list "A")  
(b) SL 1-3, Index of Publications in Stock  
(c) SL 1-2, Index of Authorized Supply and Maintenance Pub  
(d) MCO P5400.6 List of Marine Corps Activities  
(e) MCB 5215, Marine Corps Directives Quarterly check list

1. Attached is address label. Please type your address on this mailing label and attach it to your requisition to accelerate processing of your requisition.

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B. Submit justification for any DMR (date material required) less than 30 days from date of request.

C. Submit separate requisition for each different group of prefix code. i.e. 320 - FM's 351 - Dept of Army TM's, etc.

D. Separate requisitions are also required for letter-type Marine Corps Directives and CLASSIFIED items. as prescribed by references (a), (b), (c), and (e).

E. Double-space between each item.

F. List each item in numerical sequence by Prefix Control Number as well as Publication Number as listed in references (b) and (c).

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102 001026 00	MCO P1020.34A	"DL"-4	2	2

H. Changes will be automatically supplied with the basic publications. However, additional individual changes required without the basic publication should be listed separately and include prefix control number, publication symbol number, and change designator number in accordance with following format in reference (b) and (c);

<u>Prefix Control Number</u> <u>(Stock Control Number)</u>	<u>Publication Symbol</u> <u>Number</u>	<u>Change</u> <u>Number</u>
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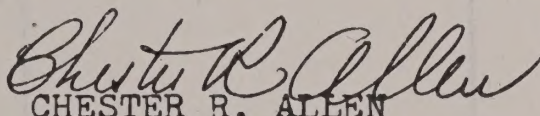
DEPARTMENT OF THE NAVY  
Headquarters, United States Marine Corps  
Washington 25, D. C.

RECORD OF CHANGES

16 May 1961

1. This publication, TM-00052A-35, is effective upon receipt and includes current information as of 1 May 1961.
2. This manual is published for the information and guidance of all concerned with Radio Sets AN/GRC-47, AN/GRC-48, and AN/MRC-40.
3. Notice of any discrepancies and suggested changes to this publication should be directed to the Commandant of the Marine Corps (Code CSY).

By direction of the Commandant of the Marine Corps



CHESTER R. ALLEN

Major General, U. S. Marine Corps  
Quartermaster General of the Marine Corps

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# RECORD OF CHANGES

CHANGE NO.	DATE ENTERED	TITLE OR BRIEF DESCRIPTION	ENTERED BY (SIG - RANK)
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1-2		Audio Power Output	2-3
1-3		Squelch Opening Levels	2-6
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## SECTION 1

### GENERAL INFORMATION

#### 1-1 CONDITIONS FOR ALIGNMENTS

For best results the equipment should be set up on a metal-topped bench located in a grounded screen room. All the equipment should be bonded to the bench. In many cases, however, a screen room and a metal-topped bench are not available. If the radio set must be aligned without them, be sure that there is a good ground connection between the radio set and the test equipment.

#### 1-2 USE OF MOBILE BENCH FOR TRANSMITTER ALIGNMENTS

Normally a mobile bench placed in front of the equipment rack prior to removing the transmitter and modulator units for alignment and/or test will be a big help. Placing the transmitter and/or modulator units on this table for alignment, will eliminate the need for an extension cable between the transmitter and the antenna cable.



## SECTION 2

### SERVICEABILITY TESTS AND ALIGNMENT PROCEDURES FOR RADIO RECEIVER, R-278( )/GR

#### 2-1 SIGNAL PLUS NOISE-TO- NOISE RATIO TEST

(4) Telephone Plug Adapter

#### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

#### c. PROCEDURE.

(1) Connect one end of the hook-up wire to a screw on the receiver chassis.

#### a. TEST EQUIPMENT REQUIRED.

(2) Place the signal generator near the receiver, and connect the

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Voltmeter	AC Sensitivity: 1 K Ohm/V Accuracy: 5% of full scale Range: 0-50 Volts	AN/PSM-4 or TS-352( )/U
Signal Generator	Frequency Range: 225 Mc-400 Mc; Amplitude Modulated; Output Z: 50 Ohms; Output Amplitude: 0-4 $\mu$ V	TS-497( )/URR or AN/URM-25( )

#### b. MATERIALS REQUIRED.

other end of the hook-up wire to the signal generator chassis.

(1) Resistor, 600-ohm, 5 watt,  
FSN 5905-193-9544

(2) Hook-up wire, No. 22 A.W.G.,  
FSN 6145-519-0909

(3) R-F cable, RG-58/U, or  
equivalent

(3) Connect and adjust the signal generator to the receiver as follows:

(a) Attach the a-c power cable to the signal generator and an a-c outlet.

(b) Set the ON-OFF switch to the ON position.

(c) Set the FREQUENCY RANGE knob to F.

(d) Position the MOD. SELECTOR knob to OFF.

(e) Adjust the FREQUENCY CONTROL knob so that the indicator is near 360.0 mc on the F scale of the MEGACYCLES dial.

(f) Connect the RG-58/U cable from the RF OUTPUT on the signal generator to the ANTENNA connector on the front of the receiver.

(g) Adjust the ATTENUATOR PAD on the signal generator to 3 microvolts.

(h) Set the MOD. SELECTOR to the 1000 cycle position.

(i) Adjust the MOD. LEVEL control to read 30% on the PERCENT MODULATION meter.

(4) Adjust and connect voltmeter to the receiver as follows:

(a) Set the function switch on the voltmeter to the ACV position.

(b) Position the RANGE switch to the 50-volt setting.

(c) Plug a telephone plug adapter into PHONES receptacle located on the front panel of the receiver.

(d) Connect two test probes to the telephone plug adapter.

(e) Connect the black test lead to the COMMON socket and the red test lead to the +V-MA OHMS socket on the voltmeter.

(f) Attach the 600-ohm resistor between the test leads at the point where they are inserted into the telephone plug adapter.

(5) Set the controls on the receiver as follows:

(a) Set the POWER ON-OFF switch to ON.

(b) Position the CHANNEL SELECTOR switch to MANUAL.

(c) Set the three numbered MANUAL CHANNEL switches to 360.5 mc.

(d) Set the AVC TIME CONSTANT COMM.-D/F switch to COMM.

(e) Set the QUIETING control to the full counterclockwise position.

(f) Set the FREQ. RESPONSE BROAD-NARROW switch to NARROW.

(g) Set the REMOTE RF GAIN-AVC OFF-LOCAL switch to LOCAL.

(h) Set the SQUELCH ON-OFF switch to the OFF position.

(i) Set the MAIN RF GAIN control fully clockwise.

as indicated on the F scale of the MEGACYCLES dial.

(j) Position the AF GAIN to 2.

(10) Repeat steps (6) and (7).

(6) Adjust the FREQUENCY CONTROL knob on the signal generator for a maximum reading on the voltmeter. If no indication is obtained, increase the setting of the AF GAIN control and repeat this step.

(11) Repeat steps (6) and (7) for a receiver and signal generator frequency of 399.9 mc.

(7) Adjust the AF GAIN control on the receiver until the voltmeter indicates a reading of 24.5 volts. If 24.5 volts cannot be obtained alignment is indicated.

(12) Throughout the above steps set AF GAIN control to 2. Set signal generator to 30% modulation and 3 microvolts output.

## 2-2 AUDIO POWER OUTPUT.

### NOTE

(8) Set the three numbered MANUAL CHANNEL switches on the receiver to 225.0 mc.

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

(9) Adjust the FREQUENCY CONTROL knob on the signal generator to approximately 225.0 mc

### a. TEST EQUIPMENT REQUIRED.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Voltmeter	AC Sensitivity: 1 K Ohm/V Accuracy: 5% of full scale	AN/PSM-4 or TS-352( )/U
Signal generator	Frequency Range: 225 Mc-400 Mc; Amplitude Modulated; Output Z: 50 Ohms; Output Amplitude: 0-100 $\mu$ V	TS-497( )/URR or AN/URM-25( )

b. MATERIALS REQUIRED.

(1) Resistor, 600 ohm, 5 watt,  
FSN 5905-193-9544

(2) Hook-up wire, No. 22 A.W.G.,  
FSN 6145-519-0909

(3) RG-58/U R-F cable or equivalent

(4) Telephone Plug Adapter

c. PROCEDURE.

(1) Connect one end of hook-up wire to a screw on the receiver chassis.

(2) Place the signal generator near the receiver, and connect the other end of the hook-up wire to the signal generator chassis.

(3) Set the POWER ON-OFF switch on receiver to the ON position and allow proper time for warm-up.

(4) Set the controls on the receiver as follows:

(a) Position the CHANNEL SELECTOR switch to MANUAL.

(b) Set the AVC TIME CONSTANT COMM-D/F switch to the COMM. position.

(c) Set the QUIETING control to the full counterclockwise position.

(d) Set the FREQ. RESPONSE BROAD-NARROW switch to NARROW.

(e) Set the REMOTE RF GAIN-AVC OFF-LOCAL switch to LOCAL.

(f) Position the SQUELCH ON-OFF switch to ON.

(g) Set the MAIN RF GAIN control to 10.

(h) Set the AF GAIN control to 10.

(i) Set the three numbered MANUAL CHANNEL switches on the receiver to 399.5 mc.

(5) Adjust and connect the signal generator to the receiver as follows:

(a) Attach the a-c power cable between the signal generator and an a-c power receptacle.

(b) Set the ON-OFF switch to the ON position.

(c) Set the FREQUENCY RANGE knob to the F position.

(d) Position the MOD. SELECTOR switch to OFF.

(e) Adjust the FREQUENCY CONTROL knob to approximately 399.5 mc as indicated on the F scale of the MEGACYCLES dial.

(f) Connect the coaxial cable from the RF OUTPUT on the signal generator to the ANTENNA connector on the front of the receiver.

(g) Adjust the ATTENUATOR PAD on the signal generator to 100 microvolts.

(h) Set the MOD. SELECTOR to the 1000 cycle position.

(i) Adjust the MOD. LEVEL control to read 30% on the PERCENT MODULATION meter.

(6) Adjust and connect the voltmeter to the receiver as follows:

(a) Set the FUNCTION switch to the ACV position.

(b) Position the RANGE switch to the 50-volt setting.

(c) Connect a telephone plug adapter into PHONES receptacle located on the front panel of the receiver.

(d) Connect two test probes into the telephone plug adapter.

(e) Connect the black test lead to the COMMON socket and the red test lead to the + V-MA OHMS on the voltmeter.

(f) Attach the 600-ohm resistor between the test leads at the point where they are inserted into the telephone plug adapter.

(7) Adjust the signal generator FREQUENCY CONTROL knob so that the F scale of the MEGACYCLES dial reads approximately 399.5 mc. Note the meter reading.

(8) Rotate the FREQUENCY CONTROL knob on the signal generator to obtain a maximum voltmeter indication.

(9) Adjust the AF GAIN control on the receiver until the voltmeter indication is 42.5 volts. If 42.5 volts cannot be obtained alignment is indicated.

(10) Repeat steps (8) and (9) with the receiver and signal generator set at the following frequencies:

(a) 389.5 mc.

(b) 379.5 mc.

(c) 369.5 mc.

(d) 359.5 mc.

(e) 349.5 mc.

(f) 339.5 mc.

(g) 329.5 mc.

(h) 319.5 mc.

(i) 309.5 mc.

(j) 299.5 mc.

(k) 289.5 mc.

(l) 279.5 mc.

(m) 269.5 mc.

(n) 259.5 mc.

(o) 249.5 mc.

(p) 239.5 mc.

(q) 229.5 mc.

(11) If 42.5 volts cannot be obtained for all of the above listed frequencies, alignment is indicated.

(12) Remove the test leads from the telephone plug adapter.

(13) Plug the test leads into pins E and F of the AUX. CONTROL or pins I and N of the LOCAL CONTROL receptacle on the front of the receiver.

(14) Attach the 600-ohm resistor between the test leads at the point where they are connected to the LOCAL CONTROL or the AUX. CONTROL receptacle.

(15) Position the RANGE switch of the voltmeter to the 10-volt setting.

(16) The meter should indicate between 2.0 and 6.2 volts, if not then alignment is indicated.

### 2-3 SQUELCH OPENING LEVELS.

#### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

#### a. TEST EQUIPMENT REQUIRED.

#### b. MATERIAL REQUIRED.

(1) Slot screwdriver.

#### c. PROCEDURE.

(1) Remove the receiver from the rack, place it on the workbench, and remove the dust cover.

(2) Pull the interlock plunger, on the receiver, to the full outward position.

(3) Connect an a-c power cable from the receiver to an a-c outlet.

(4) Set the POWER ON-OFF switch, on the front of the receiver, to the ON position.

(5) Set the signal generator ON-OFF switch to the ON position and allow sufficient time for receiver and signal generator to warm up.

(6) Connect an r-f cable from the ANTENNA jack on the front of the receiver to the RF OUTPUT plug on the signal generator.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Signal Generator	Frequency Range: 225 Mc-400 Mc; Amplitude Modulated; Output Z: 50 Ohms; Output Amplitude: 0-16 $\mu$ V	TS-497( )/URR or AN/URM-25( )
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: $\pm$ 4%; Range: 0-50 V	TS-505( )/U or ME-25( )/U

(7) Set the CHANNEL SELECTOR switch on the receiver to MANUAL.

(8) Set the three MANUAL CHANNEL switches to 303.3 mc.

(9) Set the AVC ON-OFF switch to ON.

(10) Set the DF COMM. AVC TIME CONSTANT switch to COMM.

(11) Set the FREQ. RESPONSE, BROAD-NARROW switch to BROAD.

(12) Adjust the QUIETING control to the full counterclockwise position.

(13) Adjust the AF GAIN control to the full counterclockwise position.

(14) Set the SQUELCH ON-OFF switch to the ON position.

(15) Adjust the RF GAIN control to the full clockwise position.

(16) Set the VTVM FUNCTION switch to negative DC and the RANGE switch to 40 V.

(17) Set the receiver on its left side as viewed from the front.

(18) Connect the VTVM DC probe to the AVC jack (J-606) located on the third i-f chassis. Attach the VTVM ground lead to the receiver chassis.

(19) Adjust the signal generator as follows:

(a) Set the MOD. SELECTOR switch to OFF.

(b) Adjust the FREQUENCY CONTROL knob so that 303.3 mc. is indicated on the MEGACYCLES dial.

(20) Adjust the signal generator ATTENUATOR PAD to the 500-microvolt position.

(21) Adjust the signal generator frequency control for a maximum VTVM reading.

(22) Adjust the signal generator ATTENUATOR PAD to the full counterclockwise position.

(23) CONDITION A. - If the receiver CARRIER light does not light, adjust the signal generator ATTENUATOR PAD to the right until the light comes on. The signal generator ATTENUATOR PAD reading at this point is the squelch opening level for this frequency.

(24) CONDITION B. - If the receiver CARRIER light does light, adjust the receiver RF GAIN control to the left to the point where the light goes out. Adjust the signal generator ATTENUATOR PAD until the light comes on. The ATTENUATOR PAD reading at this point is the squelch opening level for this frequency.

(25) The CARRIER light should light for the following frequencies with an input of less than 6 microvolts.

(a) 225.0 mc.

(b) 246.1 mc.

(c) 267.7 mc.

(d) 283.3 mc.

(e) 310.0 mc.

(f) 331.6 mc.

(g) 342.2 mc.

(h) 364.4 mc.

(i) 388.8 mc.

(j) 399.9 mc.

b. MATERIALS REQUIRED.

(1) Resistor, 600-ohm, 5 watt,  
FSN 5905-193-9544

(2) RG-58/U, RF cable or equivalent.

(3) Telephone Plug Adapter.

c. PROCEDURE.

(26) Disconnect the test equipment and return the receiver to its original condition.

(1) Position the Radio Receiver POWER ON-OFF switch to ON.

2-4 AVC CHARACTERISTICS.

(2) Set the three numbered MANUAL CHANNEL switches to 320.0 mc.

NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

(3) Rotate the CHANNEL SELECTOR switch to MANUAL.

a. TEST EQUIPMENT REQUIRED.

(4) Set the voltmeter FUNCTION switch to ACV and the RANGE switch to 50 V.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed) In Order of Preference)
Signal Generator	Frequency Range: Capable of 320.0 mc; Amplitude Modulated; Output Z: 50 Ohms; Output Amplitude: 10-100,000 $\mu$ V	TS-497( )/URR or AN/URM-25( )
Voltmeter	AC Sensitivity: 1 K Ohm/V; Accuracy 5% of full scale; Range: 0-50 V.	AN/PSM-4 or TS-352( )/U

(5) Connect the telephone adapter plug into the PHONES receptacle on the front of the receiver.

(6) Connect the two test probes into the telephone adapter plug.

(7) Connect the other end of the red test lead into the +V-MA OHMS socket on the voltmeter and the other end of the black test lead into the COMMON socket of the voltmeter.

(8) Attach the 600 ohm resistor between the test probes at the point where they are connected to the telephone plug adapter.

(9) Set the receiver MAIN RF GAIN control to 10, the AF GAIN to 5 and the SQUELCH switch to OFF.

(10) Adjust and connect the signal generator to the receiver as follows:

(a) Set the ON-OFF switch to ON.

(b) Set the FREQUENCY RANGE knob to F and the MODULATION SELECTOR to OFF.

(c) Adjust the FREQUENCY CONTROL knob to approximately 320.0 mc as indicated on the F scale of the MEGACYCLES dial.

(d) Connect the coaxial cable from the RF OUTPUT receptacle on the front of the signal generator to the ANTENNA receptacle on the front of the receiver.

(e) Set the ATTENUATOR PAD on the signal generator to 1000 microvolts.

(f) Set the MOD. SELECTOR to 1000 cycles.

(g) Adjust the MOD. LEVEL for a reading of 30% on the PERCENT MODULATION meter.

(h) Adjust the FREQUENCY CONTROL knob until the voltmeter indication is maximum.

(11) Adjust the receiver AF GAIN until the voltmeter indication is 24.5 volts.

(12) Adjust the signal generator ATTENUATOR PAD to the 10 microvolt position and repeat step 2-4c (10) (h).

(13) The voltmeter indication should be no less than 19.5 volts. If the reading is less than 19.5 volts, alignment is indicated.

(14) Adjust the signal generator ATTENUATOR PAD to indicate 100,000 microvolts and repeat step 2-4c (10) (h).

(15) The voltmeter indication should be no greater than 30.9 volts. If the reading is above 30.9 volts, alignment is indicated.

## 2-5 MECHANICAL SYNCHRONIZATION.

### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

a. TEST EQUIPMENT REQUIRED.

None.

b. MATERIALS REQUIRED.

(1) Slot screwdriver.

(2) Phillips head screwdriver.

c. PROCEDURE.

(1) Remove the receiver from the rack, place it on the work bench, and remove the dust cover.

(2) Pull the interlock plunger, on the receiver, to the full outward position.

(3) Connect an a-c power cable from the receiver to an a-c outlet.

(4) Set the POWER ON-OFF switch to the ON position.

(5) Rotate the CHANNEL SELECTOR switch on the receiver to MANUAL.

(6) Set the three numbered MANUAL CHANNEL switches on the receiver to 360.0 mc.

(7) Observe the position of the red dot on the coupler located ahead of the shaft which drives the R-F Amplifier Unit. See Figure 2-1. The red dot should be UP toward the top of the receiver. Step (9) will further check step (7).

(8) Set the three numbered MANUAL CHANNEL switches on the receiver to 390.0 mc.

(9) Observe the rotor bars through the access holes of all three R-F Amplifier tuners. The rotor bar in each of the tuners should be directly above the driven shaft as viewed from the top of the tuner. See Figure 2-1.

(10) Feel the gears on the shaft which drives the R-F Amplifier Unit for backlash. The gears are labeled 0-1237 and 0-1238 and are called out in Figure 2-1. Since the gear train is spring loaded, backlash movement should spring back to loading.

(11) Set the three numbered MANUAL CHANNEL switches on the receiver to 220.0 mc.

(12) Observe the rotary switch tab making contact with the right hand clip on the main Oscillator Unit. The rotary switch tab can be viewed through the hole shown in Figure 2-2.

(13) Remove the Phillips head screws from the rear plate of the receiver and remove the plate.

(14) Set the three numbered MANUAL CHANNEL switches on the receiver to 390.0 mc.

(15) Remove the three Phillips head screws holding the crystal oscillator oven cover. These screws are located at the open end of the oven cover. Do NOT remove the screws on top of this cover.

(16) Remove the crystal oven cover.

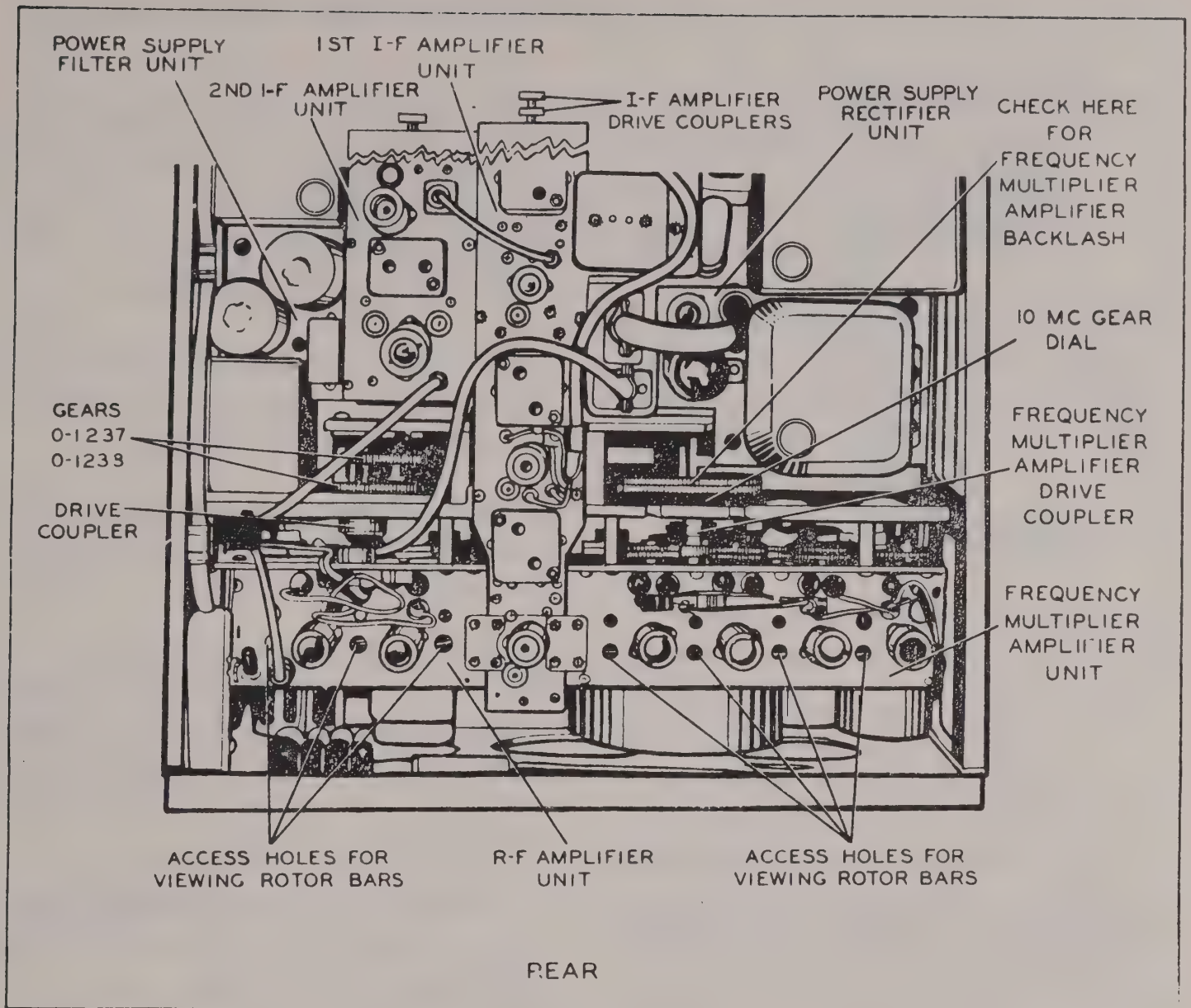


Figure 2-1 Radio Receiver R-278( )/GR, Partial Top View, Cover Removed.

(17) Observe the rotary switches which are making contact with the 38.8888 mc crystal. (Position No. 1).

(18) Feel the shaft which drives the main Oscillator Unit for any backlash. Since this shaft is not springloaded, a small backlash movement should be possible.

(19) Replace the crystal oven cover and secure it in place with the three Phillips head screws.

(20) Remove the schematic diagram cover plate which covers the Frequency Multiplier-Amplifier Unit.

(21) The shorting clip of the toroidal tuner should be on the smallest coil turn.

(22) Feel the shaft which drives the toroidal tuner for backlash movement. Since this shaft is not springloaded, a small movement should be possible.

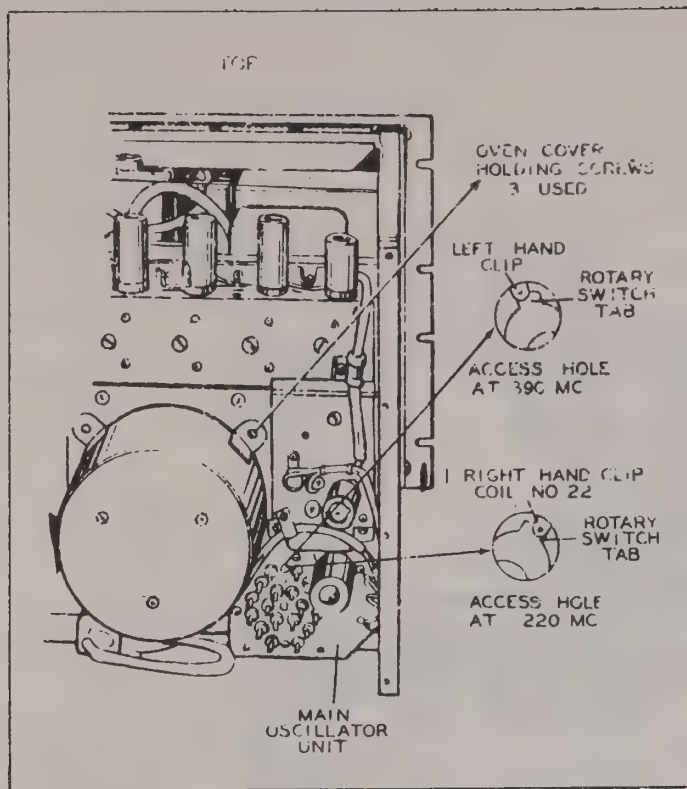


Figure 2-2 Radio Receiver R-278  
( )/GR, Partial Rear View,  
Cover Removed.

(23) The calibrated 10 MC GEAR DIAL in front of the Frequency Multiplier-Amplifier Unit should be indicating "39"

(24) Set the three numbered MANUAL CHANNEL switches on the receiver to 220.0 mc.

(25) Observe the position of the red dot on the coupler ahead of the shaft which drives the Frequency Multiplier-Amplifier Unit. The red dot should be UP toward the top of the receiver. See Figure 2-1.

(26) Observe the rotor bars through the access holes of all four Frequency Multiplier-Amplifier tuners. The rotor bars in each of these tuners should be directly beneath the driven shaft as viewed

from the top of the unit. See Figure 2-1.

(27) Feel the gears located directly forward of the 10 MC GEAR DIAL for any backlash. Since the gear train is spring loaded, backlash should spring back.

(28) Replace the schematic cover plate of the Frequency Multiplier-Amplifier Unit.

(29) Set the three numbered MANUAL CHANNEL switches to 399.9 mc.

(30) Locate two couplers on the First I-F Amplifier Unit and one coupler on the Second I-F Unit. Note that the red dots point UP toward the top of the receiver. See Figure 2-1.

(31) Set the three numbered MANUAL CHANNEL switches on the receiver to 390.0 mc.

(32) The calibrated dial gear, located forward of the First I-F Amplifier Unit, should read "0" as viewed from the top.

(33) Replace the rear panel, and secure the equipment.

## 2-6 INJECTION SYSTEM OUTPUTS.

### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

a. TEST EQUIPMENT REQUIRED.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: $\pm 4\%$ , Range: 0-25 V.	TS-505( )/U or ME-25( )/U

b. MATERIAL REQUIRED.

None.

c. PROCEDURE.

(1) Remove the receiver from its rack, remove the dust cover, and place the receiver on the work bench.

(2) Connect an a-c power cable from the receiver to an a-c outlet, and pull the interlock plunger, on the receiver, to the full outward position.

(3) Rotate the CHANNEL SELECTOR switch on the receiver to MANUAL.

(4) Set the VTVM FUNCTION switch to negative DC, position the RANGE switch to 20 V, and zero the meter.

(5) Connect the DC probe of the VTVM to receptacle J-504 and attach the VTVM ground lead to the receiver chassis. J-504 is located on the Second I-F Amplifier Unit.

(6) Set the receiver POWER ON-OFF switch to ON.

(7) Set the MANUAL CHANNEL switch marked .0, .1, .2, .3, etc., to each of its ten positions from .0 to .9 and note the VTVM indication at each setting of the switch.

(8) The VTVM indications should be no less than -7 volts at all ten settings of the .1 MC switch. Readings less than -7 indicate alignment is necessary or the oscillator has a faulty component.

(9) Remove the VTVM DC probe from J-504.

(10) Set the VTVM FUNCTION switch to negative DC and the RANGE switch to the 10 V position and zero the meter.

(11) Connect the VTVM DC probe to receptacle J-405 located on the First I-F Amplifier Unit.

(12) Set the MANUAL CHANNEL switches marked 1, 2, 3, etc., to each of its ten positions from 0 to 9 and note the VTVM indication at each of the ten settings.

(13) The VTVM indication should be between -1.5 and -3.5 volts on all ten settings, if not, alignment or faulty components is indicated.

(14) Remove the VTVM DC probe from J-405 and attach it to the exposed terminal of capacitor C-302. Capacitor C-302 is located on the Frequency Multiplier Unit.

(15) Set the VTVM FUNCTION switch to negative DC and the RANGE switch to the 2 V position.

(16) Set the MANUAL CHANNEL switch marked 22, 23, 24, etc., to each of its eighteen positions from 22 to 39 inclusive, and note the VTVM indication at each of the eighteen settings.

(17) The VTVM indications should be at least -0.5 volts on all eighteen settings, if not, alignment or faulty component is indicated.

(18) Disconnect all test equipment and return the equipment to its original condition.

## 2-7 AUDIO FREQUENCY RESPONSE.

### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

### a. TEST EQUIPMENT REQUIRED.

### b. MATERIALS REQUIRED.

(1) RG-58/U RF cable with BNC Connectors on each end.

(2) Resistor, 600-ohm, 5 watt, FSN 5905-193-9544.

(3) Telephone Plug Adapter.

### c. PROCEDURE.

(1) Interconnect the signal generator, audio oscillator and radio receiver as follows:

(a) Connect the receiver power cable to an a-c outlet.

(b) Set the receiver POWER ON-OFF switch to the ON position.

(c) Connect the RG-58/U cable from the receiver ANT. receptacle to the OUTPUT connector on the signal generator.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Audio Oscillator	Frequency Range: 200 cps to 20 K cps, variable; Accuracy: $\pm 2\%$ of dial calibration	TS-382( )/U
Voltmeter	AC Sensitivity: 1 K Ohm/V; Accuracy: 5% of full scale; Range: 0-50 V.	AN/PSM-4 or TS-352( )/U
Signal Generator	Frequency Range: capable of 320.0 Mc output; Provisions for external amplitude modulations; Output Z: 50 Ohms; Output Amplitude: 3 $\mu$ V	TS-497( )/URR or AN/URM-25( )

(d) Connect an RG-58/U cable from the OUTPUT receptacle of the audio oscillator to the EXT. MOD. connector on the front of the signal generator.

(e) Connect the signal generator and the audio oscillator to an a-c outlet. Allow sufficient warmup time (30 min.).

(f) Turn audio oscillator ON-OFF switch to ON.

(g) Set the RANGE or FREQUENCY MULTIPLIER switch on the audio oscillator to X10.

(h) Set the ATTENUATOR to 10, or set the OUTPUT MULTIPLIER to VOLTS X10 on the audio oscillator.

(i) Set the INCREASE or OUTPUT control on the audio oscillator fully counterclockwise.

(j) Set the frequency dial on the audio oscillator to 100.

(k) Set the signal generator POWER-ON switch to ON.

(l) Set the MOD. SELECTOR switch on the signal generator to EXT. MOD.

(m) Set the RANGE switch on the signal generator to F.

(n) Set the FREQUENCY CONTROL knob on the signal generator to indicate 320 on the F scale of the dial.

(o) Set the ATTENUATOR PAD on the signal generator to 3 microvolts.

(p) Adjust the MOD. LEVEL control on the signal generator to its center position.

(2) Adjust and connect the voltmeter to the receiver as follows:

(a) Set the function switch to the ACV position.

(b) Position the RANGE switch to the 50 volt setting.

(c) Connect a telephone plug adapter into PHONES receptacle located on the front panel of the receiver

(d) Connect two test probes to the telephone plug adapter.

(e) Connect the black test lead to the COMMON socket and the red test lead to the + V-MA OHMS socket on the voltmeter.

(f) Attach the 600-ohm resistor between the test leads at the point where they are inserted into the telephone plug adapter.

(3) Set the receiver controls as follows:

(a) Set the CHANNEL SELECTOR knob to MANUAL.

(b) Set the three numbered MANUAL CHANNEL switches to 320.0 mc.

(c) Set the AVC TIME CONSTANT COMM.-D/F switch to the COMM. position.

(d) Set the QUIETING control to its full counterclockwise position.

(e) Set the FREQUENCY RESPONSE BROAD-NARROW switch to NARROW.

(f) Set the RF GAIN-REMOTE FG GAIN-AVC OFF-LOCAL switch to LOCAL.

(g) Turn the SQUELCH ON-OFF switch to OFF.

(h) Set the MAIN RF GAIN control fully clockwise.

(i) Set the AF GAIN control to the 2 position.

(4) Increase the OUTPUT LEVEL control on the audio oscillator to read 30% on the PERCENT MODULATION meter of the signal generator.

#### NOTE

The PERCENT MODULATION meter should indicate a steady reading of 30% during the remainder of the procedure.

(5) Adjust the FREQUENCY CONTROL knob on the signal generator for the highest indication on the voltmeter. If no indication is obtained, increase the setting of the AF GAIN control and repeat this step.

(6) Adjust the AF GAIN control on the receiver until the voltmeter

reading is 24.5 volts. If 24.5 volts cannot be obtained, alignment is indicated.

(7) Set the audio oscillator FREQUENCY CONTROL to 20.

(8) Set the RANGE switch on the voltmeter to the 10-volt position. The voltmeter indication should be less than 7.75 volts, if not, alignment is indicated.

(9) Set the RANGE switch on the voltmeter to the 50-volt position.

(10) Rotate the audio oscillator FREQUENCY CONTROL to 40. The voltmeter indication should be no less than 14 volts. If the indication is less than 14 volts, alignment is indicated.

(11) Set the audio oscillator RANGE or FREQUENCY MULTIPLIER switch to the X100 position and the FREQUENCY CONTROL to 30. The voltmeter indication should be no less than 14 volts.

(12) Set the audio oscillator FREQUENCY CONTROL to 50.

(13) Set the RANGE switch on the voltmeter to the 10-volt position. The voltmeter indication should be less than 7.75 volts.

(14) Set the RANGE switch on the voltmeter to the 50-volt position.

(15) Set the receiver FREQ. RESPONSE BROAD-NARROW switch to the BROAD position.

(16) Set the audio oscillator RANGE or FREQUENCY MULTIPLIER switch to X10 and rotate its FREQUENCY CONTROL between 20

and 200 for the highest reading on the voltmeter.

(17) Adjust the receiver AF GAIN for a voltmeter reading of 24.5 volts. If 24.5 volts cannot be obtained, alignment is indicated.

(18) Set the audio oscillator FREQUENCY CONTROL to 20. The voltmeter indication should be no less than 15.5 volts.

(19) Set the audio oscillator RANGE or FREQUENCY MULTIPLIER switch to X1000 position. The voltmeter indication should be no less than 15.5 volts.

(20) Disconnect all test equipment and return the receiver to its original condition.

## 2-8 SECOND I-F AMPLIFIER ALIGNMENT.

### NOTE

The following procedures shall be performed by personnel at the third echelon of maintenance or higher.

### a. TEST EQUIPMENT REQUIRED.

### b. MATERIALS REQUIRED.

(1) Phillips screwdriver.

(2) Slot screwdriver.

(3) Headset.

(4) Hook-up wire No. 22 A.W.G., FSN 6145-519-0909.

(5) Resistor, 50-ohm, 1/2 watt, carbon type, FSN 5905-279-3517.

(6) Screwdriver, nonmetallic.

### c. PROCEDURE.

(1) Remove the receiver from the rack, remove the dust cover, and place the unit on a test bench.

(2) Pull the interlock switch at the rear of the unit to its full outward position and set the TRACKING CONTROL to NORMAL.

(3) Connect an a-c power cable from the receiver to an a-c receptacle.

(4) Plug the headset into the PHONES receptacle on the front of the receiver.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Signal Generator	Frequency Range: Capable of 9.5 Mc; Output Z: 50 Ohms; Output Amplitude: 0-100,000 $\mu$ V; Accuracy: 0.5%	AN/URM-25( ) or TS-497( )/URR
VTVM	DC Sensitivity: 13 M Ohm/V; Accuracy: $\pm$ 4%, Range: 0-4 V	TS-505( )/U or ME-25( )/U

(5) Remove the Third I-F Amplifier Unit as follows.

(a) Set the Receiver on its left side.

(b) Disconnect the r-f cable from the Third I-F Amplifier and disconnect the plug on the cable leading from the unit.

(c) Loosen the four red-headed captive screws and remove the Third I-F Amplifier Unit from the receiver.

(d) Set the Third I-F Amplifier Unit near enough such that the cables will reach their connectors on the receiver.

(e) Reconnect the r-f cable and the input cable to the Third I-F Amplifier.

(6) Remove tubes V-402 and V-404 from the First I-F Amplifier Unit.

(7) Connect the VTVM as outlined below:

(a) Set the VTVM FUNCTION switch to negative DC, the RANGE switch to 4V, and zero the meter.

(b) Insert the DC probe into J-606 on the Third I-F Amplifier Unit, and connect the VTVM ground lead to the receiver chassis.

(8) Adjust and connect the signal generator as follows:

(a) Connect the R.F. OUTPUT X-MULT receptacle of the signal

generator through the 50-ohm resistor to receptacle J-404 on the First I-F Amplifier Unit. Connect the shield of the output cable to ground on the First I-F Amplifier chassis.

(b) Turn the CARRIER CONTROL full counterclockwise.

(c) Turn the MICROVOLTS CONTROL full clockwise.

(d) Turn the PERCENT MODULATION CONTROL full counterclockwise.

(e) Turn the POWER ON-OFF switch to OFF

(f) Connect the power cable to an a-c outlet.

(g) Turn the POWER ON-OFF switch to ON. Allow 15 minutes for warmup.

(h) Check the meter switch for zero meter reading in all three positions. Place in RF position. On the D-Model generator, set the switch on the CARRIER-CW.

(i) Set the FREQUENCY BAND SWITCH to band G. Use the 3.0 to 9.5 mc band on the D-Model generator.

(j) Set the CARRIER RANGE switch to the DEFG position or to the 230 KC-16 MC position. On the D-Model generator, set the CARRIER RANGE switch to the 300 KC-50 MC X MULT. position.

(k) Rotate the frequency tuning dial to select a frequency of 9.5 mc.

(l) Adjust the CARRIER CONTROL or SET CARRIER control for full-scale indication on the MICROVOLTS scale of the meter.

(m) Set the RF MULTIPLIER switch to the 1 position.

(n) Set the MOD. SELECTOR switch to OFF. This adjustment is not required on the D-Model signal generator.

(9) Set the receiver controls as follows:

(a) Set the MAIN RF GAIN control to 10.

(b) Position the SQUELCH control to OFF.

(c) Set the AVC TIME CONSTANT COMM.-D/F switch to COMM.

(d) If testing on R-278/GR, set the AVC switch to ON.

(e) Set the CHANNEL SELECTOR to position 1.

(f) Set the three numbered CHANNEL switches to 229.5 mc on Channel 1.

(g) Set the POWER ON-OFF switch to the ON position. Allow 15 minutes warmup time.

(10) Rotate the signal generator frequency control around 9.5 mc and adjust the MICROVOLTS control

until the VTVM indication is approximately 3.5 volts.

(11) Set the signal generator frequency control for the highest reading on the VTVM.

(12) Adjust the MICROVOLTS control of the signal generator for a reading of 3.5 volts as the highest.

(13) Using a nonmetallic screwdriver, adjust first the SECONDARY and then the PRIMARY cores of T-502, and then the SECONDARY and PRIMARY cores of T-501 for a maximum VTVM indication. Turn the signal generator MICROVOLTS control AFTER EACH ADJUSTMENT to maintain 3.5 volts as indicated in Step (12).

#### NOTE

The core adjusting screws are visible in the holes marked "T-502 PRI-CORE SEC-CORE" and T-501 PRI-CORE SEC-CORE" in Figure 2-3.

(14) Set the receiver POWER ON-OFF switch to OFF, replace the Third I-F Amplifier and return the equipment to its original condition.

#### 2-9 FIRST I-F AMPLIFIER ALIGNMENT.

#### NOTE

The following procedures shall be performed by personnel at the THIRD ECHELON OF MAINTENANCE or higher.

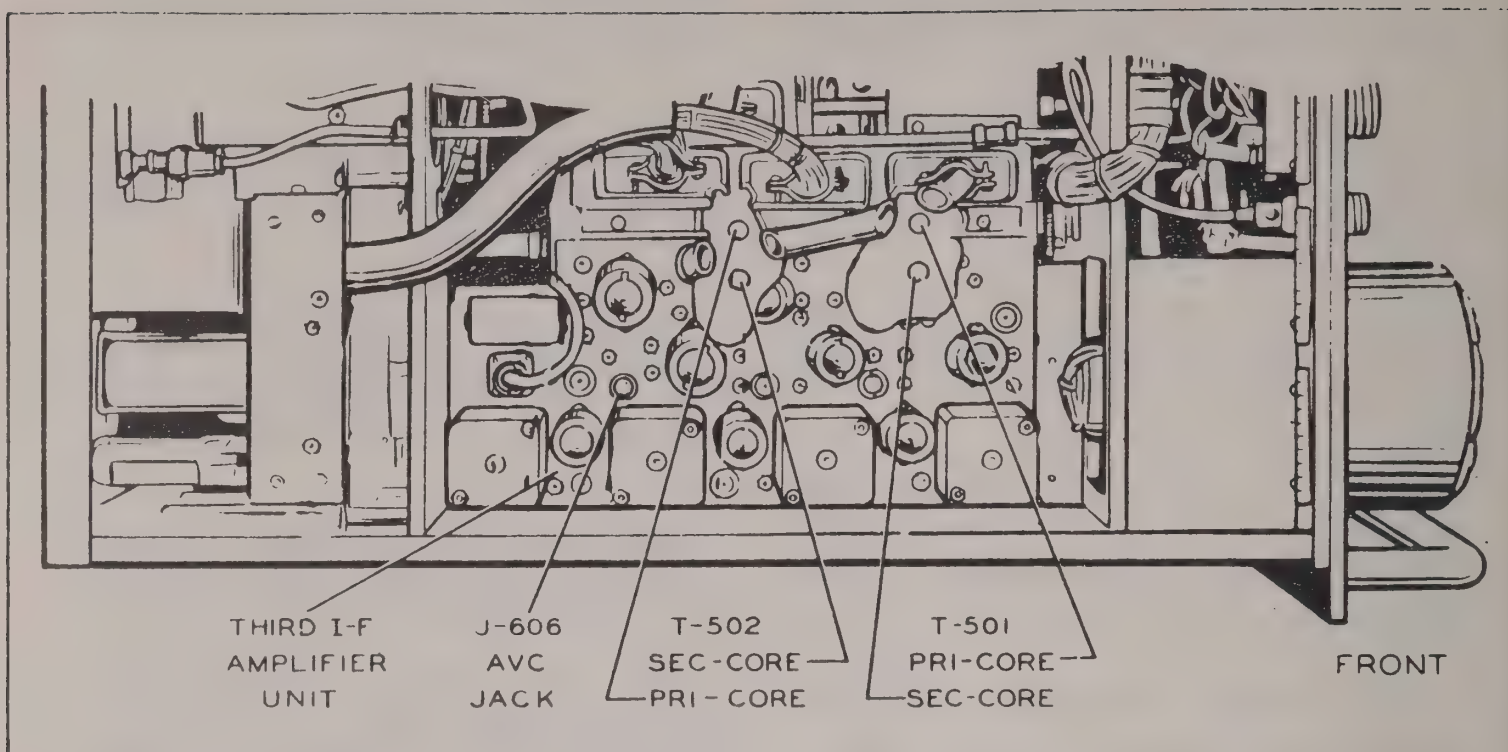


Figure 2-3 Radio Receiver R-278( )/GR, Partial Bottom View, Cover Removed.

a. TEST EQUIPMENT REQUIRED.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Signal Generator	Frequency Range: Capable of 9.5 Mc; Output Z; 50 Ohms; Output Amplitude: 0-100,000 $\mu$ V; Accuracy 0.5%	AN/URM-25( ) or TS-497( )/URR
VTVM	DC Sensitivity: 13 M Ohm/V; Accuracy: $\pm 4\%$ , Range: 0-4 V	TS-505( )/U or ME-25( )/U

b. MATERIALS REQUIRED.

(4) Headset.

(1) Slot screwdriver.

(5) Turning Wand (See Figure 2-4) 2 ea.

(2) Phillips screwdriver.

(3) Screwdriver, nonmetallic.

(6) Resistor, 50-ohm, 1/2 watt, carbon type, FSN 5905-279-3517.

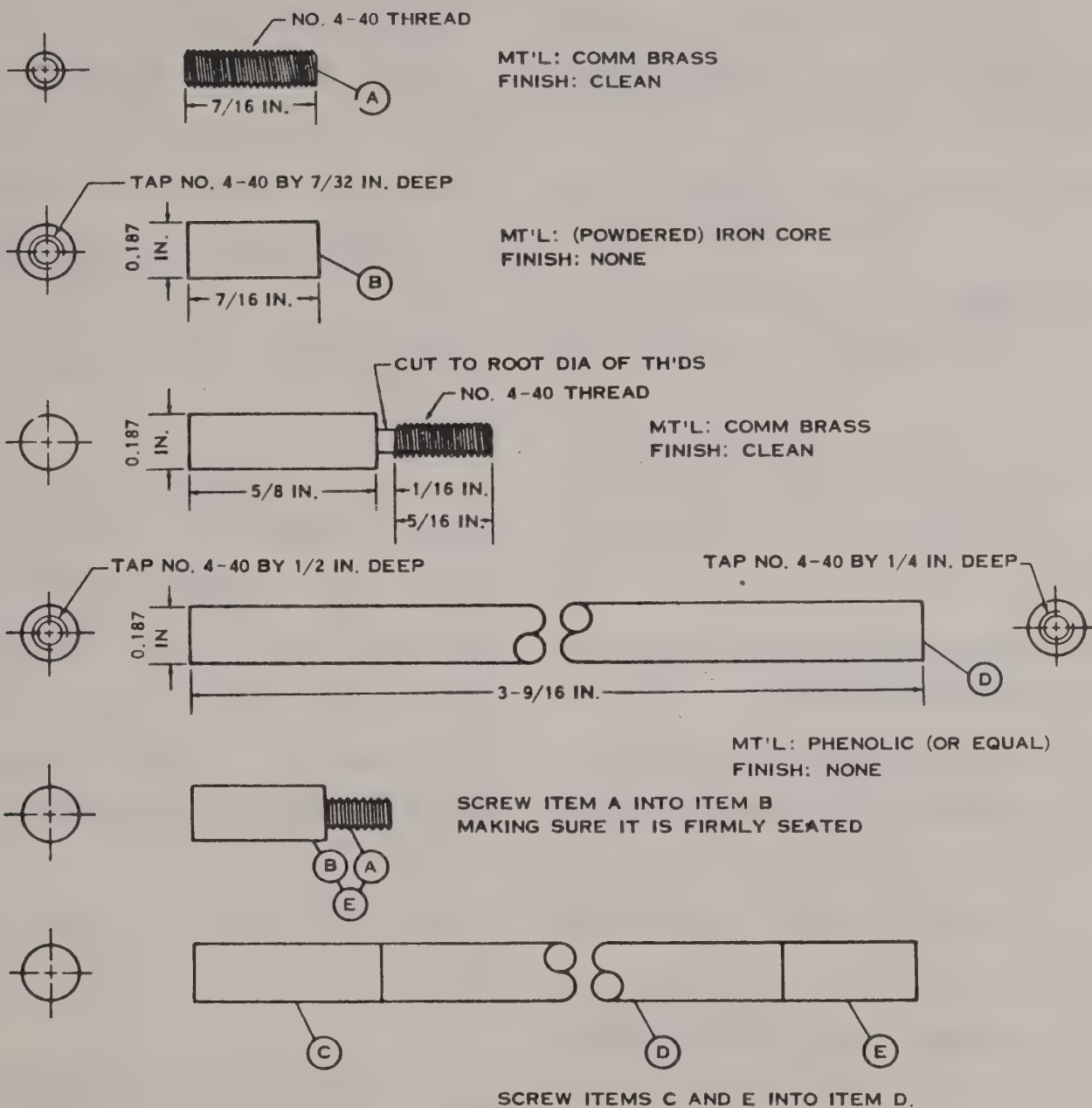


Figure 2-4 Tuning Wand Fabrication Details.

c. PROCEDURE.

(1) Remove the receiver from the rack, remove the dust cover, and place the unit on a test bench.

(2) Pull the interlock switch to its full outward position and set the TRACKING CONTROL to NORMAL.

(3) Connect an a-c power cable from the receiver to an a-c outlet.

(4) Plug the headset into the PHONES receptacle on the front of the receiver.

(5) Remove tube V-102 from the F-F Amplifier Unit and tube V-305 from the Frequency Multiplier Amplifier.

(6) Adjust and connect the VTVM in the following manner:

(a) Set the RANGE switch to 4 V, set the FUNCTION switch to negative DC, and zero the meter.

(b) Connect the DC probe of the VTVM to receptacle J-405.

(c) Connect the VTVM ground lead to the receiver chassis.

(7) Set the receiver controls as follows:

(a) Set the MAIN RF GAIN to 10.

(b) Set the SQUELCH switch to OFF.

(c) Position the AVC TIME CONSTANT COMM.-D/F switch to COMM.

(d) If testing an R-278/GR, set the AVC switch to ON.

(e) Set the CHANNEL SELECTOR to 1 and set the POWER ON-OFF to ON.

(8) Set the receiver on its right side.

(9) Align the second oscillator tank circuit, T-403, of the First I-F Amplifier Unit as follows:

(a) Set the three numbered CHANNEL switches to 229.0 mc on Channel 1.

(b) Using a nonmetallic screwdriver, adjust the "T-403 PRI-TRIM" for maximum indication on the VTVM. Record this reading. See Figure 2-5 for the location of "T-403 PRI-TRIM".

(c) Set the three numbered CHANNEL switches on the receiver to 220.0 mc on Channel 1.

(d) Adjust the "T-403 PRI-CORE" for a maximum indication on the VTVM. Record this reading.

(e) Repeat steps (a) through (d) until no further VTVM increase can be obtained over those recorded readings in steps (b) and (d).

(f) Disconnect the plug from connector J-505 located on the Second I-F Amplifier Unit.

(g) Disconnect the VTVM DC probe from J-405 and connect it to J-404.

(h) Set the three numbered CHANNEL switches to 229.0 mc on Channel 1.

(i) Adjust the secondary trimmer of T-403 for a maximum VTVM indication and record the reading.

(j) Set the ~~three~~ numbered CHANNEL switches to 220.0 mc on Channel 1.

(k) Adjust "T-403 SEC-CORE", as shown in Figure 2-5, for a maximum VTVM indication and record this reading.

(l) Repeat steps (h) (i) (j) and (k) until no further increase can be obtained over the readings recorded in Steps (i) and (k).

(m) Set the three numbered CHANNEL switches to 229.0 mc and check the alignment as follows:

1. Locate the hole in can T-403 which is nearest the front panel of the receiver and insert first the brass end of the tuning wand and then the iron end of the wand. Note the VTVM reading.

2. Insert the brass end of the tuning wand; and then the iron end of the wand into the opposite hole in T-403. Note the VTVM reading.

3. Repeat steps 1. and 2. at the other nine settings of the 1 MC frequency selector switch. If the VTVM readings increase no more than 0.5 volts in steps 1., 2. or 3., the oscillator is aligned properly. Proceed to step (12) below. However,

if the VTVM readings increase more than 0.5 volt, perform the following steps:

4. Disconnect the VTVM DC probe from J-404 and connect it to J-405.

5. Connect the plug to J-505 on the Second I-F Amplifier Unit.

6. Repeat steps 2-9c(9)(a) through 2-9c(9)(m) as required.

(10) Connect the plug to Connector J-505 on the Second I-F Amplifier Unit.

(11) Disconnect the VTVM DC probe from J-404 and connect it to the AVC receptacle, J-606, located on the Third I-F Amplifier Unit.

(12) Connect and adjust the Signal Generator as outlined below:

(a) Turn the CARRIER CONTROL fully counterclockwise.

(b) Turn the MICROVOLTS control fully clockwise.

(c) Turn the PERCENT MODULATION control fully counterclockwise.

(d) Connect the power cable to input receptacle.

(e) Turn the POWER ON-OFF switch to ON. Allow 15 minutes warmup time.

(f) Check the meter switch for zero meter reading in all three positions. Place in RF position.

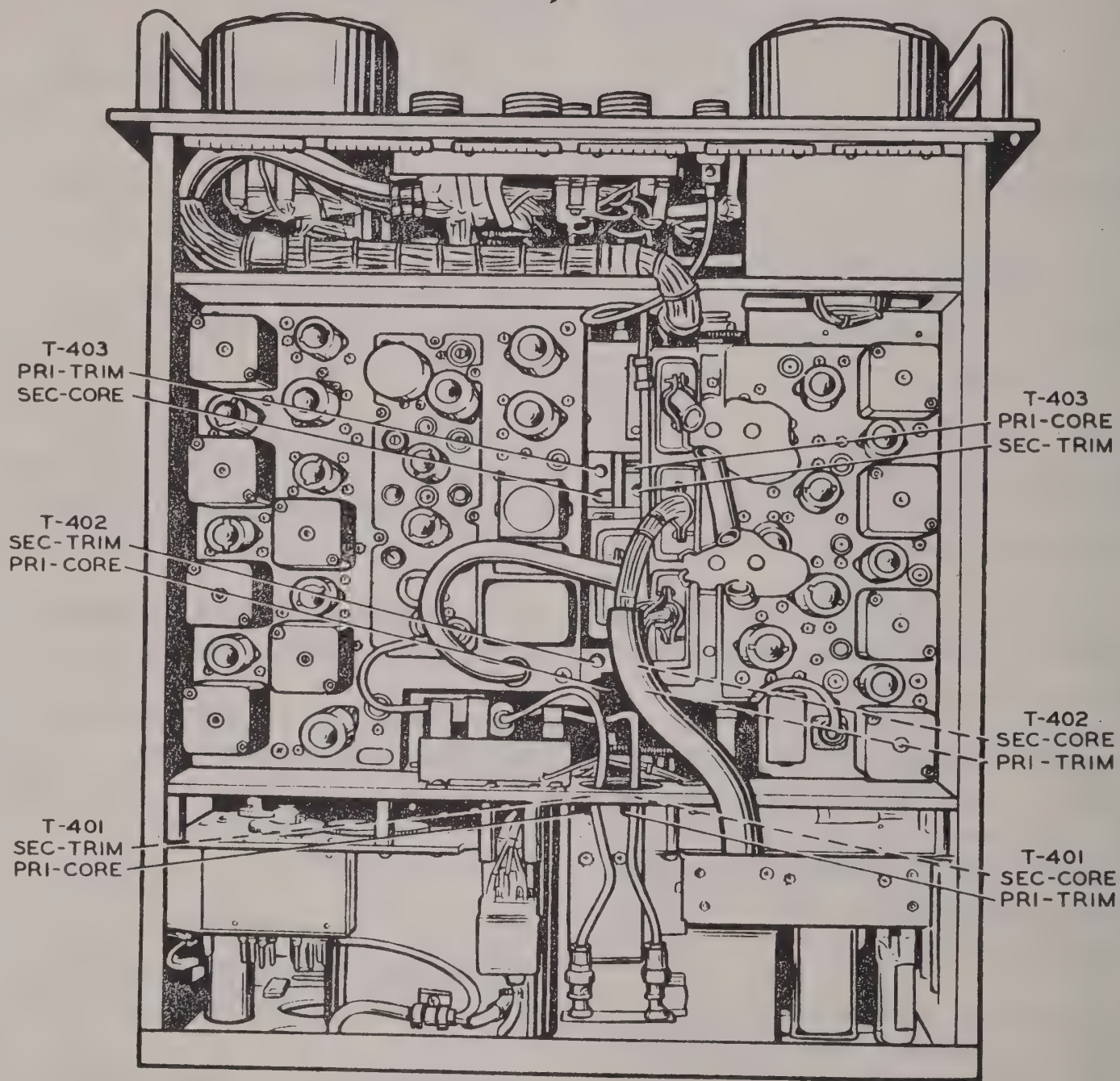


Figure 2-5 Radio Receiver R-278 ( )/GR, Bottom View, Cover Removed

(g) Set the FREQUENCY BAND SWITCH to band H. Use the 30-50 mc band on the D-Model Signal Generator.

(h) Set the CARRIER RANGE switch to band H.

(i) Rotate the frequency tuning dial to select a frequency of 45.0 mc.

(j) Connect the R.F. OUTPUT X-MULT receptacle (J-102) of the signal generator through the 50-ohm resistor to receptacle J-402 on the First I-F Amplifier Unit. Connect the shell of the signal generator output connector to the receiver chassis, using a convenient length of hookup wire.

(k) Set the CARRIER CONTROL or SET CARRIER control for full-scale indication on the MICROVOLTS scale of the meter

(l) Set the RF MULTIPLIER switch to the 100 position.

(m) Set the MOD. SELECTOR switch to OFF.

(13) Align the trimmers of T-401 and T-402 as follows:

(a) Set the three numbered CHANNEL switches on the receiver to 225.0 mc.

(b) Adjust the signal generator MICROVOLTS control for a VTVM indication of 3.5 volts.

(c) Locate the hole on top of T-401 which is nearest the rear of the receiver and insert the iron end of the tuning wand.

(d) Adjust the secondary trimmer of T-401 for maximum indication on the VTVM. See Figure 2-5.

(e) Adjust the signal generator MICROVOLTS control for a reading of 3.5 volts as indicated on the VTVM.

(f) Remove the iron end of the tuning wand and insert it into the opposite hole of T-401.

(g) Adjust the primary trimmer of T-401 for a maximum indication on the VTVM. See Figure 2-5.

(h) Adjust the signal generator MICROVOLTS Control for a reading of 3.5 volts as indicated on the VTVM.

(i) Remove the Iron end of the tuning wand from T-401 and insert it into the hole in T-402 which is nearest the rear of the receiver.

(j) Adjust "T-402 SEC-TRIM" for a maximum reading on the VTVM. See Figure 2-5.

(k) Adjust the signal generator MICROVOLTS control for a reading of 3.5 volts as indicated by the VTVM.

(l) Remove the Iron end of the tuning wand and insert it into the other hole on T-402.

(m) Adjust "T-402 PRI-TRIM" until a maximum VTVM indication is obtained.

(n) Remove the tuning wand.

(14) Align tank circuits T-401 and T-402, of the First I-F Amplifier as follows:

(a) Set the three numbered CHANNEL switches to 220.0 mc on Channel 1.

(b) Set the signal generator frequency at 40.0 mc and adjust the MICROVOLTS control for a 3.5 volt reading on the VTVM.

(c) Insert the Iron end of the tuning wand into the hole in the top of T-401 which is nearer the rear of the receiver.

(d) Using another tuning wand insert first the brass end and then the iron end in and out of the other hole in T-401. Observe any change in the VTVM reading.

(e) If the VTVM reading decreases when either end of the tuning wand is inserted, the can is properly aligned.

(f) If the VTVM reading increases when the brass end is inserted, or if the reading increases more than 0.5 volts when the iron end is inserted, adjust the tuning coils as follows:

1. If the brass end increased the VTVM reading, turn the "T-401 SEC-CORE" adjustment one-half turn in a counterclockwise direction.

2. If the iron end increased the VTVM reading more than 0.5 volts, turn the "T-401 SEC-CORE" adjustment one-half turn in a clockwise direction.

3. Repeat steps (d), (e), and (f) above, until the VTVM indicates a decrease when the brass end of the wand is inserted into T-401, and an increase of less than 0.5 volt when the iron end of the wand is inserted into T-401.

(g) Remove the Iron end of the first tuning wand and insert it into the hole in T-401 which is nearer the front of the receiver.

(h) Insert first the brass end of a second tuning wand, and then the iron end of the wand into and out of the other hole in T-401. Observe any change in the VTVM reading.

(i) If the VTVM reading decreases when either end of the tuning wand is inserted, the can is properly aligned. If the iron end causes an increase of less than 0.5 volt, the can is aligned properly.

(j) If the VTVM reading increases when the brass end is inserted, or if the reading increases more than 0.5 volt when the iron end is inserted, adjust the tuning coils as follows:

1. If the brass end increased the meter reading, turn the "T-401 PRI-CORE" adjustment one-half turn in a counterclockwise direction.

2. If the iron end increased the reading more than 0.5 volt, turn the "T-401 PRI-CORE" adjustment one-half turn in a clockwise direction.

3. Repeat steps (h), (i), and (j) above, until the VTVM indicates

a decrease when the brass end of the wand is inserted into T-401, and an increase of less than 0.5 volts when the iron end of the wand is inserted into T-401.

(k) Remove the iron end of the first tuning wand from T-401 and insert it into the hole in T-402 which is nearer the rear of the receiver.

(l) Insert first the brass end of a second tuning wand, and then the iron end of the wand into and out of the hole in T-402. Observe any change in the VTVM reading.

(m) If the VTVM reading decreases when either end of the tuning wand is inserted, the can is properly aligned. If the iron end of the wand causes an increase of less than 0.5 volt, the can is properly aligned.

(n) If the VTVM reading increases when the brass end of the wand is inserted, or if the reading increases more than 0.5 volt when the iron end is inserted, adjust the tuning coils as follows:

1. If the brass end increased the VTVM reading, turn the "T-402 SEC-CORE" adjustment one-half turn in a counterclockwise direction.

2. If the iron end increased the VTVM reading more than 0.5 volt, turn the "T-402 SEC-CORE" adjustment one-half turn in a clockwise direction.

3. Repeat steps (l), (m), and (n) above, until the VTVM indicates a decrease when the brass end of

the wand is inserted into T-402, and an increase of less than 0.5 volt when the iron end of the wand is inserted into T-402.

(o) Remove the iron end of the first tuning wand from the hole in T-402 and insert it into the hole in T-402 which is nearer the front of the receiver.

(p) Insert first the brass end of the second tuning wand, and then the iron end of the tuning wand into and out of the hole in T-402. Observe any change in the VTVM reading.

(q) If the VTVM reading decreases when either end of the wand is inserted, the can is properly aligned. If the iron end of the wand causes an increase of less than 0.5 volt, the can is properly aligned.

(r) If the VTM reading increases when the brass end of the wand is inserted, or if the reading increases more than 0.5 volt when the iron end is inserted, adjust the tuning coils as follows:

1. If the brass end increased the VTVM reading, turn "T-402 PRI-CORE" adjustment one-half turn in a counterclockwise direction.

2. If the iron end increased the VTVM reading more than 0.5 volt, turn the "T-402 PRI-CORE" adjustment one-half turn in a clockwise direction.

3. Repeat steps (p), (q), and (r) above until the VTVM indicates a decrease when the brass end of

the tuning wand is inserted into T-402, and an increase of less than 0.5 volt when the iron end of the wand is inserted into T-402.

(s) Remove the iron end of the first tuning wand from T-402.

(t) Set the three numbered CHANNEL switches to 229.9 mc.

(u) Set the signal generator frequency to 49.9 mc and set the MICROVOLTS control for a 3.5 volt VTVM indication.

(v) Insert the iron end of a tuning wand into the hole in the top of T-401 which is nearer the rear of the receiver.

(w) Pass first the brass end and then the iron end of a second tuning wand into and out of the other hole in T-401. Observe any change in the VTVM indication.

(x) If the VTVM reading decreases with either end of the tuning wand inserted, or if insertion of the iron end increases the reading by less than 0.5 volt, the trimmer is correctly aligned.

(y) If the conditions of Step (x) above are not met, adjust "T-401 SEC-TRIM" until the VTVM indication is maximum.

(z) Remove the iron end of the first tuning wand and insert it into the hole in the top of T-401 which is nearer the front of the receiver.

(aa) Pass first the brass end and then the iron end of the second

tuning wand in and out of the other hole in T-401. Observe any change in the VTVM indication.

(bb) If the VTVM reading decreases with each end of the tuning wand inserted, or if insertion of the iron end increases the meter reading by less than 0.5 volts, the trimmer is properly aligned.

(cc) If the conditions of Step (bb) above are not met, adjust "T-401 PRI-TRIM" for a maximum VTVM indication.

(dd) Remove the iron end of the first tuning wand from T-401 and insert it into the hole in T-402 which is nearer the rear of the receiver.

(ee) Pass first the brass end and then the iron end of the second tuning wand into the other hole in T-402. Observe any change in the VTVM indication.

(ff) If the VTVM reading decreases with each end of the tuning wand inserted, or if insertion of the iron end increases the VTVM reading by less than 0.5 volts, the trimmer is properly adjusted.

(gg) If the VTVM indicates an increase of more than 0.5 volt with the insertion of the iron end of the tuning wand, or if the VTVM indicates any increase with the insertion of the brass end of the wand, adjust the "T-402 SEC-TRIM" until a maximum reading is obtained on the VTVM.

(hh) Remove the iron end of the first tuning wand and insert it into the hole in T-402 which is nearer the front of the receiver.

(ii) Pass first the brass end and then the iron end of a second tuning wand into and out of the other hole in T-402. Observe any change in the VTVM indication.

(jj) If the VTVM reading decreases with either end of the tuning wand inserted, or if the iron end of the tuning wand inserted, or if the iron end causes the VTVM reading to increase less than 0.5 volts, the trimmer is properly adjusted.

(kk) If the conditions as stated in Step (jj) above are not met, adjust "T-402 PRI-TRIM" for a maximum VTVM indication.

(ll) Remove the iron end of the first tuning wand and repeat Steps 2-9c(14)(a) through 2-9c(14)(kk) until no further improvement is obtained.

(15) Turn the receiver POWER ON-OFF switch to the OFF position, disconnect and return the equipment to its original condition.

2-10 MAIN OSCILLATOR ALIGNMENT

NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

a. TEST EQUIPMENT REQUIRED.

b. MATERIALS REQUIRED.

- (1) Slot screwdriver.
- (2) Headset.
- (3) Screwdriver, nonmetallic.

c. PROCEDURE.

(1) Remove the receiver from the mounting rack, remove the dust cover, and place the unit on a test bench.

(2) Remove the rear frame plate from the receiver and locate the coil adjusting screws at the lower right corner of the equipment. See Figure 2-6.

(3) Connect an a-c power cable from the receiver to an a-c outlet.

(4) Plug the headset into the PHONES receptacle on the front of the receiver.

(5) Pull the interlock switch on the rear of the receiver to its full outward position and set the TRACKING CONTROL switch to NORMAL.

(6) Adjust and connect the VTVM in the following manner:

(a) Set the FUNCTION switch to negative DC.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: ± 4%, Range 0-4 V	TS-505( )/U or ME-25( )/U

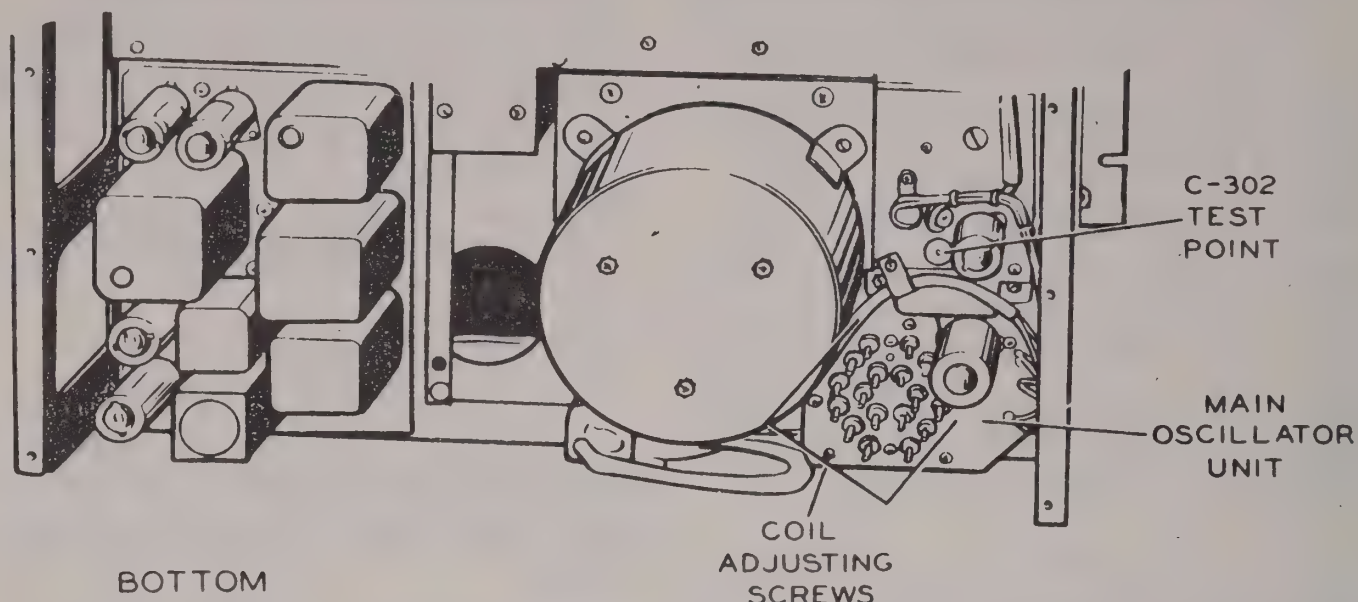


Figure 2-6 Radio Receiver R-278 ( )/GR, Partial Rear View,  
Cover Removed

(b) Position the RANGE switch to the 2 V setting and zero the meter.

(c) Attach the DC probe to C-302 TEST POINT. See Figure 2-6.

(d) Connect the VTVM ground lead to the receiver chassis.

(7) Set the receiver POWER ON-OFF switch to the ON position.

(8) Align the Oscillator coils as follows:

(a) Set the CHANNEL SELECTOR on the receiver to Position 1.

(b) Set the three numbered CHANNEL switches to 395.0 mc on Channel 1.

(c) Turn the coil adjusting screw numbered 39 all the way in flush with the study slot and then back it out until the VTVM indicates a maximum reading.

(d) Set the TRACKING CONTROL from NORMAL to OFF and back to NORMAL. The VTVM indication should return. If the reading does not return, perform Step (e). If the reading returns, proceed to Step (9).

(e) Turn the coil adjusting screw in a counterclockwise direction until the VTVM reading returns then turn the screw  $1/8$  turn counterclockwise.

(9) Set the three numbered CHANNEL switches to the frequencies listed in the steps following and adjust the corresponding coil adjusting screws for a maximum VTVM reading. After each CHANNEL switch setting, adjust the appropriate coil adjusting screw in the manner given in Steps 2-10c(8)-(c) and 2-10c(8)(d).

(a) 385.0 mc, screw number 38.

(b) 375.0 mc, screw number 37.

(c) 365.0 mc, screw number 36.

- (d) 355.0 mc, screw number 35.
- (e) 345.0 mc, screw number 34.
- (f) 335.0 mc, screw number 33.
- (g) 325.0 mc, screw number 32.
- (h) 315.0 mc, screw number 31.
- (i) 305.0 mc, screw number 30.
- (j) 295.0 mc, screw number 29.
- (k) 285.0 mc, screw number 28.
- (l) 275.0 mc, screw number 27.
- (m) 265.0 mc, screw number 26.
- (n) 255.0 mc, screw number 25.
- (o) 245.0 mc, screw number 24.
- (p) 235.0 mc, screw number 23.
- (q) 225.0 mc, screw number 22.

(10) Disconnect all cables and return the equipment to its original condition.

2-11 FREQUENCY MULTIPLIER-AMPLIFIER ALIGNMENT.

CAUTION

The following procedures shall be performed by personnel at the THIRD ECHELON of MAINTENANCE or higher.

a. TEST EQUIPMENT REQUIRED.

b. MATERIALS REQUIRED.

- (1) Tuning Wand. See Figure 2-4.
- (2) Headset.
- (3) Sector Bending Tool, made from a blunt scribe with the sides ground flat.
- (4) Slot Screwdriver.
- (5) Screwdriver, nonmetallic.
- (6) Resistor, 470,000 ohms, 1/2 watt, carbon type.
- (7) Hookup wire.

c. PROCEDURE.

- (1) Remove the receiver from the mounting rack, remove the dust cover, and place the unit on a test bench.
- (2) Remove the rear frame plate from the end of the chassis so that trimmers Z-301, Z-303, Z-305, Z-307, and Z-309 are accessible. See Figure 2-7.
- (3) Connect an a-c power cable from the receiver to an a-c outlet.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: ± 4%; Range: 0-10 V; AC Sensitivity: 6 M Ohms/V; Accuracy: ± 6%, Range: 0-25 V	TS-505( )/U or ME-25( )/U

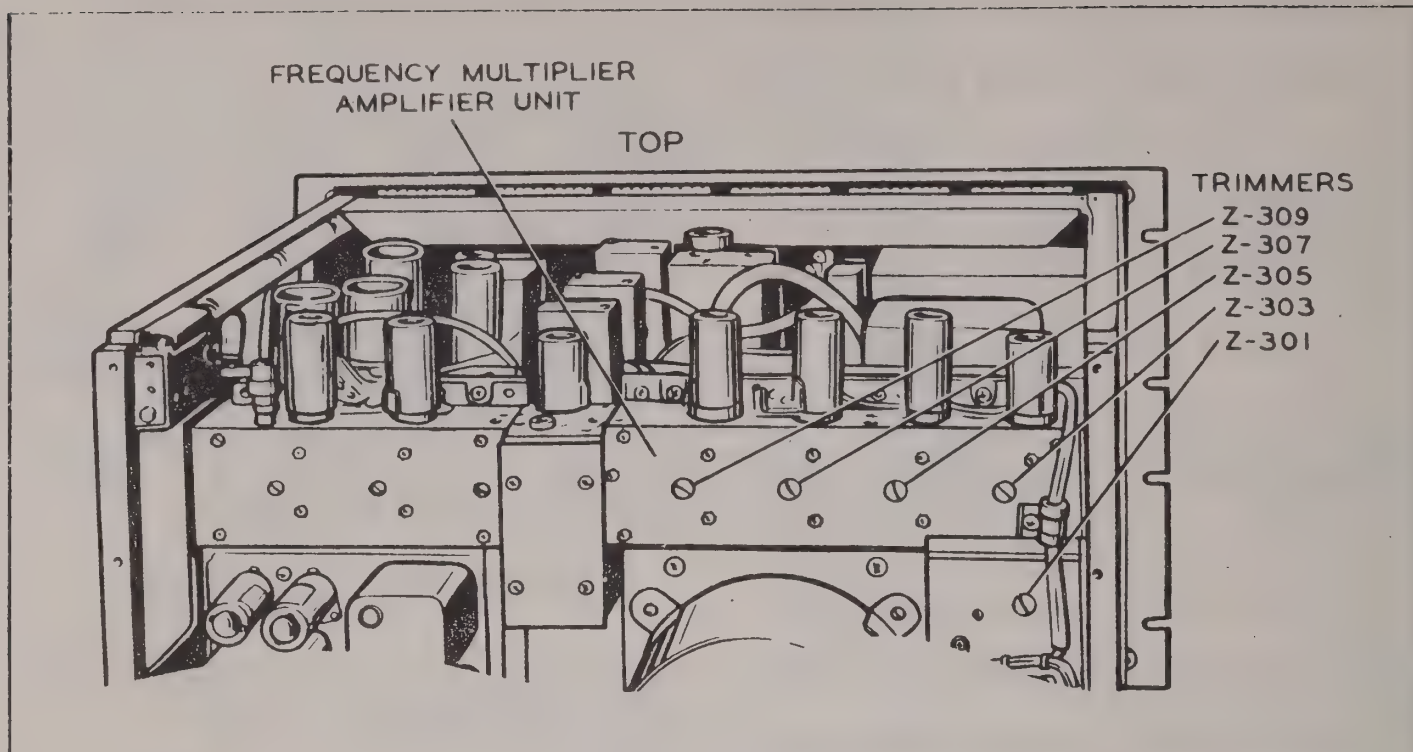


Figure 2-7 Radio Receiver R-278 ( )/GR, Partial Rear View,  
Cover Removed

(4) Plug the headset into the PHONES receptacle located on the front of the receiver.

(5) Pull the interlock switch on the rear of the receiver chassis to its full outward position and set the TRACKING CONTROL switch to NORMAL.

(6) Remove the screws from the Frequency Multiplier-Amplifier end cover plate on the left side of the receiver chassis but leave the cover in place.

(7) Adjust and connect the VTVM to the receiver as follows:

(a) Position the RANGE switch to 4 V, the FUNCTION switch to negative DC, and zero the meter.

(b) Connect the DC probe to capacitor C-309. C-309 is located on

the top right side of the Frequency Multiplier-Amplifier Unit.

(c) Connect the VTVM ground lead to the receiver chassis.

(8) Set the receiver controls as outlined in the following steps:

(a) Position the CHANNEL SELECTOR switch to 1.

(b) Set the POWER ON-OFF switch to ON.

(9) Align trimmer Z-301 as outlined in the following steps:

(a) Set the three numbered switches to 320.0 mc on Channel 1.

(b) Adjust the Z-301 trimmer until the VTVM indication is maximum.

(c) Set the three numbered CHANNEL switches to 390.0 mc on Channel 1.

(d) Slide the end cover plate upward far enough to insert first the brass end of the tuning wand and then the iron end of the wand close to the coil visible under the cover. Observe the VTVM indication. If the VTVM reading increased when the brass end of the wand was inserted, turn the TRACKING CONTROL to OFF, spread the turns of the coil slightly, and then turn the TRACKING CONTROL to NORMAL. If the VTVM reading increased when the iron end of the tuning wand was inserted, turn the TRACKING CONTROL to OFF, compress the coil to bring the turns closer together, and turn the TRACKING CONTROL to NORMAL.

(e) Set the three numbered CHANNEL switches to 320.0 mc on Channel 1.

(f) Repeat Step (9)(b) above.

(g) Set the three numbered CHANNEL switches to 390.0 mc on Channel 1 and repeat Step (9)(d) above.

(h) Repeat Steps (9)(a) through (9)(g) above until a minimum tuning difference occurs between the frequency settings 320.0 mc and 390.0 mc.

(10) Secure the side cover plate.

(11) Align trimmers Z-303, Z-305, Z-307, and Z-309 as follows:

(a) Set the three numbered CHANNEL switches to 380.0 mc on Channel 1.

(b) Disconnect the VTVM DC probe from C-309 and set the VTVM FUNCTION switch to AC.

(c) Remove tube V-303 and connect the VTVM AC PROBE to pin 2 of XV-303.

(d) Adjust trimmer Z-303 until a maximum reading is obtained on the VTVM.

(e) Remove the AC PROBE from XV-303, replace V-303 in its tube socket, remove V-304, and connect the AC PROBE to pin 2 of XV-304.

(f) Adjust Z-305 for a maximum VTVM indication.

(g) Remove the AC PROBE from XV-304, replace V-304 in its tube socket, remove V-305, and connect the AC PROBE to pin 2 of XV-305.

(h) Adjust trimmer Z-307 until the reading on the VTVM is maximum.

(i) Remove the AC PROBE from XV-305 and replace V-305 in its tube socket.

(j) Set the VTVM FUNCTION switch to negative DC, zero the meter, and connect one lead of the 470,000 ohm resistor to the DC probe of the VTVM.

(k) Connect the other resistor lead to J-402 using a convenient length of hook-up wire. J-402 is located on the first I-F Amplifier Unit.

(l) Adjust trimmer Z-309 for a maximum VTVM reading.

(m) With the equipment in its present condition, repeat Steps (d), (f), (h), and (l) above.

(12) Align the Z-303, Z-305, Z-307, and Z-309 r-ftuning capacitors as follows:

#### NOTE

The tuning capacitors consist of two stator plates and three rotor plates, the front and rear rotor plates being radially slotted into sectors which can be bent closer or farther away from the adjacent stator plates. Refer to Figure 2-8. The tuning capacitors are aligned by bending the front or rear sector of rotor plates which are half engaged at the frequency under consideration.

In order to locate the proper sector, each is numbered and color coded. In order that the proper sector can be reached in the access hole, the TRACKING CONTROL switch is positioned to RUN, long enough to drive the gear behind the 10 MC INDICATOR DIAL so the proper number or letter on the gear lines up with the mark on the dial.

The table in this step lists the sector color code, the

number, and also the dial position required for each setting of the CHANNEL switches. 380.0 mc is the tuner tracking point, at which there is no sector.

(a) Set the three numbered CHANNEL switches to the first setting given in Table 2-1.

(b) Insert first the brass end of the tuning wand and then the iron end of the wand into the front access hole of Z-303. Observe the VTVM reading.

(c) If the VTVM reading DECREASED when either end was inserted into the hole, the tuner is aligned properly and no alignment is necessary. If the VTVM reading INCREASED when either end was inserted, proceed as follows:

1. Set the TRACKING CONTROL switch to RUN, long enough to position the 10 MC INDICATOR DIAL to the setting listed in Table 2-1.

2. Look through the rear access hole of Z-303 and determine the sector color. The SECTOR column of Table 2-1 will aid in determining the proper sector.

3. If the VTVM reading increased when the brass end was inserted into the front access hole, bend the sector AWAY FROM the adjacent capacitor stator plate. Use the sector bending tool and bend the sector only a small amount.

4. If the VTVM reading increased when the iron end was inserted in tuner Z-303, bend the sector CLOSER TO the adjacent

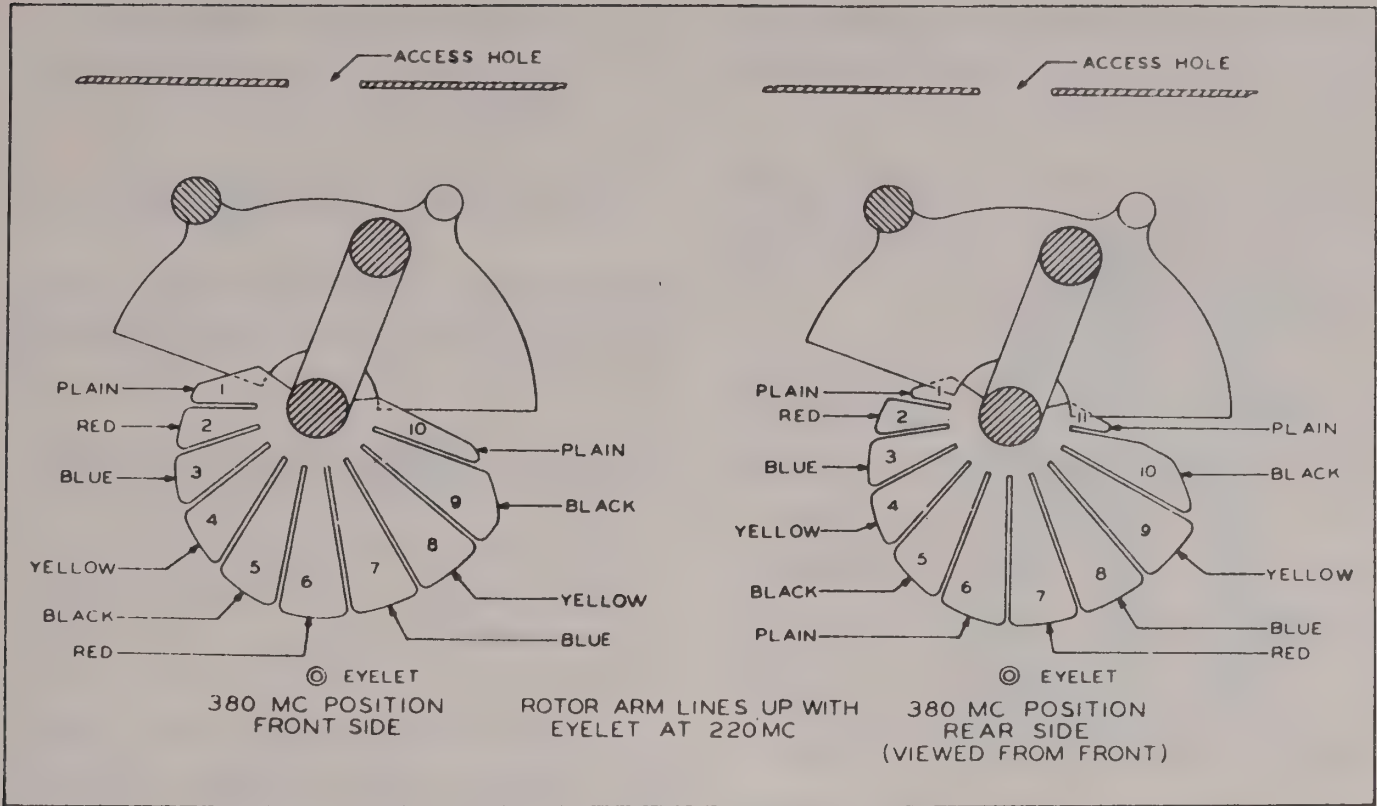


Figure 2-8 Radio Receiver R-279 ( )/GR, Frequency Multiplier-Amplifier Unit, Tuner Capacitor Sectors

TABLE 2-1. Frequency Multiplier-Amplifier Alignment Points.

CHANNEL SWITCH SETTING	INDICATOR DIAL POSITION	SECTOR	
		NUMBER*	COLOR
390.0	I	10- FRONT	PLAIN
370.0	30	1- FRONT	PLAIN
360.0	29	2- BACK	RED
350.0	28	2- FRONT	RED
340.0	27	3- BACK	BLUE
330.0	26	3- FRONT	BLUE
320.0	25	4- BACK	YELLOW
310.0	24	4- FRONT	YELLOW
300.0	23	5- BACK	BLACK
290.0	22	5- FRONT	BLACK
280.0	A	6- BACK	PLAIN
270.0	B	6- FRONT	RED
260.0	C	7- BACK	RED
250.0	D	7- FRONT	BLUE
240.0	E	8- BACK	BLUE
230.0	F	8- FRONT	YELLOW
220.0	G	9- BACK	YELLOW

\*Back indicates rotor plate next to ceramic end plate.

Front indicates rotor plate toward drive shaft.

capacitor stator plate. Use the sector bending tool and bend the sector only a small amount.

5. Set the TRACKING CONTROL switch to NORMAL and repeat Steps (b) and (c) above for tuners Z-305, Z-307 and Z-309.

6. Steps (b) and (c) above shall be repeated until the insertion of either end of the tuning wand causes a decrease in the VTVM reading.

(d) Set the three numbered CHANNEL switches on the receiver to the other settings given in Table 2-1 and perform Steps (b) and (c) above for each frequency setting.

(13) Set the TRACKING CONTROL switch to NORMAL, set the receiver POWER ON-OFF switch to OFF. Disconnect all test equipment and return the equipment to its original condition.

## 2-12 R-F AMPLIFIER ALIGNMENT

### CAUTION

The following procedures shall be performed by personnel at the THIRD ECHELON OF MAINTENANCE or higher.

#### a. TEST EQUIPMENT REQUIRED.

#### b. MATERIALS REQUIRED.

(1) Slot Screwdriver.

(2) Screwdriver, nonmetallic.

(3) Sector Bending Tool, made from a blunt scribe with the sides ground flat.

(4) Phillips head Screwdriver.

(5) Tuning wand. See Figure 2-4.

#### c. PROCEDURE.

(1) Remove the receiver from its mounting rack, remove the dust cover, and place the unit on a test bench.

(2) Pull the interlock switch on the rear of the receiver chassis to its full outward position.

(3) Connect an a-c cable from the receiver to an a-c outlet.

(4) Set the VTVM FUNCTION switch to negative DC, the RANGE switch to 10 V, and zero the meter.

(5) Connect the VTVM DC probe to receptacle J-606 located on the Third I-F Amplifier Unit.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Signal Generator	Frequency Range: 225 Mc-400 Mc; Unmodulated; Output Z: 50 Ohms; Output Amplitude: 0-120 $\mu$ V	TS-497( )/URR or AN/URM-25( )
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: $\pm$ 4%, Range: 0-10 V.	TS-505( )/U or ME-25( )/U

(6) Connect the VTVM ground lead to the receiver chassis.

(7) Adjust and connect the Signal Generator as described in the following steps:

(a) Attach the a-c power cable to the signal generator and set the ON-OFF switch to the ON position.

(b) Set the FREQUENCY RANGE knob to F and the MOD. SELECTOR switch to OFF.

(c) Adjust the FREQUENCY CONTROL knob to approximately 360.0 mc as indicated on the F scale of the MEGACYCLES dial.

(d) Connect an R-F cable from the signal generator OUTPUT jack to the ANTENNA jack on the front of the receiver.

(e) Set the ATTENUATOR PAD to 90-microvolts.

(8) Set the receiver POWER ON-OFF switch to the ON position.

(9) Rotate the CHANNEL SELECTOR on the receiver to Channel 1 and set the MAIN RF GAIN to 10.

(10) Set the three numbered CHANNEL switches on the receiver to 360.5 mc on Channel 1.

(11) Adjust the FREQUENCY CONTROL on the signal generator until the VTVM indication is maximum.

(12) Adjust the ATTENUATOR PAD of the signal generator until the VTVM indication is -3.5 volts. Adjust the ATTENUATOR PAD to -3.5 volts on the VTVM after each check and adjustment before further adjustments are made.

(13) Adjust trimmers Z-101, Z-102, and Z-103, in this order, for a

maximum VTVM reading. See Figure 2-9.

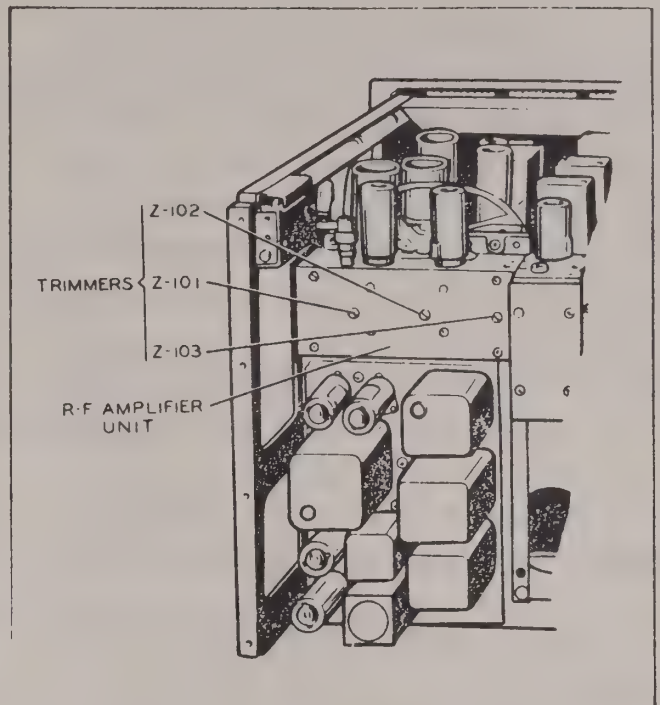


Figure 2-9 Radio Receiver R-278 ( )/GR, Partial Rear View, Cover Removed.

(14) Perform testing and sector adjustments of the r-ftuners Z-101, Z-102, and Z-103 in the following manner:

(a) Set the three numbered CHANNEL switches on the receiver to 365.5 mc on Channel 1.

(b) Adjust the signal generator to 365.5 mc and repeat Steps (11) and (12).

(c) Test each tuner by inserting either end of the tuning wand into the access holes on top of the R-F Amplifier Unit. Observe the VTVM reading while inserting the tuning wand.

(d) If insertion of the brass end of the tuning wand into any of the R-F tuners increases the VTVM reading, operate the TRACKING

CONTROL switch to RUN until the 10-mc dial gear indicator points to M. Observe that sector number 11 (plain - on rotor plate nearest trimmer), is accessible through the access hole. Bend sector number 11 AWAY FROM the stator plate with the sector bending tool. Return the TRACKING CONTROL switch to NORMAL and observe the VTVM indication while inserting the brass end of the tuning wand. The VTVM indication will decrease if the adjustment was sufficient. If the VTVM indication still increases, repeat this step until the insertion of the brass end of the tuning wand causes the VTVM indication to decrease.

(e) If insertion of the iron end of the tuning wand in any of the r-f

tuners causes an increased VTVM reading, operate the TRACKING CONTROL switch to RUN until the 10-mc dial gear indicator points to M. Bend sector 11 TOWARD the stator plate with the sector bending tool. Return the TRACKING CONTROL switch to NORMAL and observe the VTVM indication while inserting the iron end of the tuning wand. The VTVM indication will decrease if the adjustment was sufficient. If the VTVM indication still increases, repeat this step until insertion of the iron end of the tuning wand causes the VTVM indication to decrease.

(f) Repeat Steps (a), (b), (c), (d), and (e) above at each of the frequencies listed in Table 2-2.

TABLE 2-2. R-F Amplifier Alignment Points

CHANNEL SWITCH SETTING	INDICATOR DIAL POSITION	SECTOR	
		NUMBER*	COLOR
395.5	J	9- FRONT	BLACK
385.5	K	10- BACK	BLACK
375.5	L	10- FRONT	PLAIN
355.5	28	1- FRONT	PLAIN
345.5	27	2- BACK	RED
335.5	26	2- FRONT	RED
325.5	25	3- BACK	BLUE
315.5	24	3- FRONT	BLUE
305.5	23	4- BACK	YELLOW
295.5	22	4- FRONT	YELLOW
285.5	A	5- BACK	BLACK
275.5	B	5- FRONT	BLACK
265.5	C	6- BACK	PLAIN
255.5	D	6- FRONT	RED
245.5	E	7- BACK	RED
235.5	F	7- FRONT	BLUE
225.5	G	8- BACK	BLUE

(15) Disconnect the test equipment and return the equipment to its original condition.

## 2-13 CRYSTAL FREQUENCY CHECK

### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

### a. TEST EQUIPMENT REQUIRED.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Frequency Counter	High Input Z; capable of counting from 7 Mc-40 Mc; Accuracy: $\pm 50$ cps at 40 Mc.	AN/USM-26 or AN/USM-122

### b. MATERIAL REQUIRED.

(1) R-F Cable, RG-62 or equivalent.

(2) Connector (one), UG-260, FSN 5935-173-5895.

(3) Capacitor, 360 micromicrofarad, FSN 5910-101-5636.

(4) Hookup wire, no. 22 A.W.G., FSN 6145-519-0909.

### c. PROCEDURE.

(1) Test the Main Oscillator in the following manner:

(a) Remove the receiver from its mounting rack, remove the dust

cover, and place the unit on a test bench.

(b) Form a coil of about four turns, using No. 22 A.W.G. insulated hookup wire.

(c) Connect the R-F cable to the SIGNAL INPUT on the frequency counter.

(d) Connect one end of the coil of hook-up wire to the r-f cable.

(e) Place the four turn coil between the Main Oscillator chassis

and the Frequency Multiplier-Amplifier chassis.

(f) Adjust the frequency counter as outlined on page 27 of the AN/USM-26 handbook.

(g) Set the receiver POWER ON-OFF switch to the ON position.

(h) Rotate the CHANNEL SELECTOR switch on the receiver to Channel 1.

(i) Set the three numbered CHANNEL switches to 390.0 mc on Channel 1.

(j) Set the gate time on the frequency counter to 0.1 or 1.0 second.

If the crystal is functioning properly the counter will count a frequency of 38.8889 mc.

(k) Repeat Steps (h), (i), and (j) above for the INDICATOR DIAL SETTINGS given in Table 2-3.

(1) The tolerance of these crystals is .002%.

(2) Test the First IF Oscillator in the following manner:

(a) Set the three numbered CHANNEL switches on the receiver to 369.0 mc on Channel 1.

(b) Connect the r-f cable from the SIGNAL INPUT receptacle, on

the frequency counter, through the 360 mmf capacitor to J-405. J-405 is located on the Second I-F Amplifier Unit.

(c) Set the gate time on the frequency counter to 10 seconds and take readings of the following INDICATOR DIAL SETTINGS given in Table 2-4.

(d) The tolerance of these crystals is .005%.

(3) Test the Second I-F Oscillator in the following manner:

(a) Set the three numbered CHANNEL switches on the receiver to 360.9 mc on Channel 1.

TABLE 2-3. Frequencies for Main Oscillator Test.

INDICATOR DIAL SETTING	R.F. BAND MC.	INJECTION FREQ. MC.	CRYSTAL FREQ. MC.
22	220.0 - 229.9	180.0	30.0000
23	230.0 - 239.9	190.0	31.6667
24	240.0 - 249.9	200.0	33.3333
25	250.0 - 259.9	210.0	35.0000
26	260.0 - 269.9	220.0	36.6667
27	270.0 - 279.9	230.0	38.3333
28	280.0 - 289.9	240.0	26.6667
29	290.0 - 299.9	250.0	27.7777
30	300.0 - 309.9	260.0	28.8888
31	310.0 - 319.9	270.0	30.0000
32	320.0 - 329.9	280.0	31.1111
33	330.0 - 339.9	290.0	32.2222
34	340.0 - 349.9	300.0	33.3333
35	350.0 - 359.9	310.0	34.4444
36	360.0 - 369.9	320.0	35.5555
37	370.0 - 379.9	330.0	36.6667
38	380.0 - 389.9	340.0	37.7778
39	390.0 - 399.9	350.0	38.8889

TABLE 2-4. Frequencies for  
First I-F Oscillator Test.

INDICATOR DIAL SETTING	FIRST I-F BAND MC.	CRYSTAL FREQ. MC.
0	40.0 - 40.9	31.0
1	41.0 - 41.9	32.0
2	42.0 - 42.9	33.0
3	43.0 - 43.9	34.0
4	44.0 - 44.9	35.0
5	45.0 - 45.9	36.0
6	46.0 - 46.9	37.0
7	47.0 - 47.9	38.0
8	48.0 - 48.9	39.0
9	49.0 - 49.9	40.0

(b) Connect the r-f cable from the SIGNAL INPUT receptacle on the frequency counter, through the 360 mmf. capacitor to J-503. J-503 is located on the Second I-F Amplifier Unit.

(c) Set the gate time on the frequency counter to 1 or 10 seconds

and check each crystal at the following INDICATOR DIAL SETTING given in Table 2-5.

TABLE 2-5. Frequencies for Second I-F Oscillator Test.

INDICATOR DIAL SETTINGS	SECOND I-F FREQ. MC.	CRYSTAL FREQ. MC.
.0	9.0	6.95
.1	9.1	7.05
.2	9.2	7.15
.3	9.3	7.25
.4	9.4	7.35
.5	9.5	7.45
.6	9.6	7.55
.7	9.7	7.65
.8	9.8	7.75
.9	9.9	7.85

(d) The tolerance of these crystals is .005%.

(4) Disconnect test equipment and return the equipment to its original condition.



## SECTION 3

### SERVICEABILITY TESTS AND ALIGNMENT PROCEDURES FOR RADIO TRANSMITTER T-217( )/GR AND MODULATOR-POWER SUPPLY MD-129( )/GR

#### 3-1 PANEL METER READINGS

##### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

##### a. TEST EQUIPMENT REQUIRED.

None

##### b. MATERIALS REQUIRED.

(1) Microphone, T-17, or equivalent.

(2) Insulated Screwdriver.

##### c. PROCEDURE.

(1) Turn the Transmitter and Modulator-Power Supply on by following the steps given below.

(a) Open the front panel door on the upper right-hand corner of the modulator and set the NORMAL-EMERG. Switch to NORMAL, the VOICE-MCW CARRIER ON switch to VOICE, the AUDIO BANDWIDTH

NARROW-BROAD switch to NARROW, and refer to the instructions located on the inside of the panel door for the setting of the switches labeled AUDIO GAIN and LIMITER CONTROL.

(b) Connect the antenna cable to the OMNI. ANT. jack on the front of the transmitter.

(c) Make sure that the large cable, CX-1564, from the jack labeled TRANSMITTER on the modulator is connected. This cable runs between the transmitter and the modulator units.

(d) Make sure that the coaxial cable, CG-693/U, from the TRANSMITTER jack, located on the modulator, to the HIGH VOLTAGE jack, located on the transmitter, is connected.

(e) Make sure that the cable from the POWER receptacle on the modulator to the a-c power outlet is connected.

(f) Set the POWER ON-OFF switch on the modulator to the ON

position. Allow 15 minutes before taking readings.

(g) Set the METER SELECTOR switch on the transmitter to the POWER OUTPUT-WATTS position.

(h) Set the METER SELECTOR switch on the modulator to the P.A. PL. position.

(i) Rotate the CHANNEL SELECTOR knob on the transmitter to MANUAL.

(j) Set the three numbered MANUAL CHANNEL switches on the transmitter to 225.2 mc.

(k) Set the VOICE-MCW CARRIER ON switch, inside the modulator front panel door, to MCW CARRIER.

(l) Read the meter on the transmitter. The meter should indicate no less than 100 on the 0-200 scale. If the reading is less than 100, alignment is indicated.

(m) Read meter M-1402 on the modulator. The meter should indicate no more than 420 on the 0-500 scale. If the reading is more than 420, alignment is indicated.

(n) Set the METER SELECTOR switch on the transmitter to the P.A. GRID position.

(o) Read the meter on the transmitter. The reading should be no less than 0.2 on the 0-10 scale. If

the reading is less than 0.2, alignment is indicated.

(p) Set the VOICE-MCW CARRIER ON switch on the modulator to the VOICE position.

(q) Set the three numbered MANUAL CHANNEL switches on the transmitter to 336.5 mc.

(r) Repeat steps (k) and (l). Minimum is 90 watts at this frequency. Repeat steps (n) through (p).

(s) Set the three numbered MANUAL CHANNEL switches on the transmitter to 399.9 mc.

(t) Repeat steps (k) and (l). Minimum is 85 watts at this frequency.

(2) To test the performance of the transmitter intermediate stages, the percent of modulation, and the indicated panel meter readings on the modulator, set the respective meter selector switches as follows:

(a) Plug the microphone into the modulator MICROPHONE jack and each time a switch is positioned, refer to Table 3-1, press the microphone push-to-talk switch.

(b) If readings deviate from those given, alignment is indicated.

(3) Return the Transmitter and Modulator controls to their original positions.

TABLE 3-1. Transmitter and Modulator Performance Checks

Set METER SELECTOR Switch on Modulator To:	READ
% MOD.	Adjust the AUDIO GAIN to read 95 on the peaks when speaking into the mike (0-125% scale).
MOD. PL.	30 to 50, with mike covered (0-500 scale).
DR. PL.	55 to 90. (0-125 scale).
AMP. PL.	30 to 60. (0-125 scale).
2 DRIVER GRID	No less than 3 (0-10 scale).
3 DRIVER GRID	No less than 2 (0-10 scale).
S.W.R. CAL.	Adjust S.W.R. CAL. knob to CAL. on the red scale.
S.W.R.	Less than 2.5 on red scale.

## 3-2 PERCENT MODULATION TEST

## NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

## a. TEST EQUIPMENT REQUIRED.

## b. MATERIALS REQUIRED.

(1) Slot Screwdriver.

(2) R-F Cable, RG-58/U, or equivalent.

## c. PROCEDURE.

(1) Remove both transmitter and modulator from the mounting rack,

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Voltmeter	Sensitivity: 1000 Ohm/VAC; Range: 0-50 VAC; Accuracy: 7% full scale at 20 Kc.	AN/PSM-4 or TS-352( )/U
Audio Oscillator	Frequency Range: 20-2000 cps; Output Z: 1000 Ohms; Output Amplitude: 0.1 to 1.2 V.	TS-382( )/U

remove the modulator dust cover, and place the units on a workbench.

(2) Pull the interlock switch on the rear of the modulator to its full outward position.

(3) Tie back the mouse-trap shorting switch on the modulator. This switch is located on the right side of the unit as viewed from the front.

(4) Open the front panel door on the modulator and set the NORMAL-EMERG. switch to NORMAL, the VOICE-MCW CARRIER ON switch to VOICE, the AUDIO BANDWIDTH NARROW-BROAD to NARROW, the LIMITER Control to 0, and the AUDIO GAIN to 6.

(5) Set the METER SELECTOR to % MOD.

(6) Connect a coaxial cable between the OMNI. ANT. jack on the transmitter and the antenna.

(7) Connect the cable from the large TRANSMITTER jack on the modulator to the large jack on the transmitter.

(8) Connect the cable from the small TRANSMITTER jack on the modulator to the HIGH VOLTAGE receptacle on the transmitter.

(9) Connect the power cable from the POWER jack on the modulator to an a-c outlet.

(10) Set the DIR. ANT.-CARRIER OFF-OMNI. ANT. control on the

transmitter to the OMNI. ANT. position.

(11) Plug the Oscillator Test Set into an a-c outlet and set the OSC. ON-OFF switch to ON. Allow 10 minutes warmup.

(12) Set the audio oscillator RANGE or FREQUENCY MULTIPLIER switch to X10, set the ATTENUATOR to .1, or set the OUTPUT MULTIPLIER to VOLTS X.1.

(13) Connect Cord CG-409A/U (P/O TS-382( )/U) to the OUTPUT jack on the audio oscillator and attach Adapter Connector UG-514/U (P/O TS-382( )/U) to the other end of the cord.

(14) Connect Adapter Connector UG-514/U to the LINE terminals on the front of the modulator.

(15) Adjust and connect the voltmeter as follows:

(a) Set the FUNCTION switch to the AVC position.

(b) Set the RANGE switch to 50-volt setting.

(c) Connect the common test lead to the modulator chassis.

(d) Connect the other test lead to E1502. E1502 is located in the upper right-hand corner of the modulator as viewed from the left side.

(16) Set the POWER ON-OFF switch on the modulator to the ON position.

(17) Set the VOICE-MCW CARRIER ON switch on the modulator to the MCW CARRIER ON position.

(18) Rotate the INCREASE control on the audio oscillator and the AUDIO GAIN control on the modulator until the voltmeter indication is 14 volts. If 14 volts cannot be obtained, alignment is indicated.

(19) The modulation meter should indicate a reading of 90. If the meter does not read 90, alignment is indicated.

(20) Return the equipment to its original condition.

3-3 TEST POINT READINGS

NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

TEST EQUIPMENT REQUIRED.

b. MATERIALS REQUIRED.

(1) Slot Screwdriver.

(2) R-F Cable, RG-58/U or equivalent.

c. PROCEDURE.

(1) Remove the transmitter and modulator from the mounting rack, remove their dust covers, and place both units on a work bench.

(2) Pull the interlock switches on the rear of both the transmitter and modulator to their full outward position.

(3) Open the panel door on the modulator and set the NORMAL-EMERG. switch to NORMAL, the VOICE-MCW CARRIER ON switch to VOICE, the AUDIO BANDWIDTH NARROW-BROAD switch to NARROW, and set the LIMITER CONTROL and the AUDIO GAIN controls according to the instructions on the inside of the panel door.

(4) Connect a coaxial cable between the OMNI. ANT. jack, on the transmitter and an antenna.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: ±4%, Range: 0-500 Volts; AC Sensitivity: 6 M Ohms/V; Accuracy: ±6%, Range: 0-10 Volts.	TS-505( )/U or ME-25( )/U

(5) Connect the cable from the large TRANSMITTER jack on the modulator to the large jack on the front of the transmitter.

(6) Tie back the mouse-trap shorting switch on the modulator. This switch is located on the right side of the unit as viewed from the front.

(7) Connect the cable from the small TRANSMITTER jack on the modulator to the HIGH VOLTAGE jack on the transmitter.

(8) Connect a power cable from the POWER jack on the modulator to an a-c outlet.

(9) Set the DIR. ANT.-CARRIER OFF-OMNI. ANT. knob on the transmitter to the OMNI. ANT. position.

(10) Set the VTVM FUNCTION switch to negative DC, the RANGE switch to 40 V, and zero the meter.

(11) Connect the VTVM DC probe to receptacle J-401 on the I-F Oscillator Unit.

(12) Attach the common lead of the VTVM to the transmitter chassis.

(13) Set the POWER ON-OFF switch on the modulator to the ON position.

(14) Rotate the CHANNEL SELECTOR to Channel 1.

(15) Set the three numbered CHANNEL switches to 220.0 mc on Channel 1.

(16) Set the VOICE-MCW CARRIER ON switch on the modulator to MCW CARRIER ON. The VTVM indication should be from 8 to 25 volts. If the reading is abnormal, alignment is indicated.

(17) Set the VOICE-MCW CARRIER ON switch to VOICE.

(18) Repeat Steps (16) and (17) at each of the following CHANNEL switch settings. Alignment is indicated with each abnormal reading.

(a) 220.1 mc

(b) 220.2 mc

(c) 220.3 mc

(d) 220.4 mc

(e) 220.5 mc

(f) 220.6 mc

(g) 220.7 mc

(h) 220.8 mc

(i) 220.9 mc

(19) Disconnect the VTVM DC probe from J-401 and connect it to J-402 on the I-F Oscillator Unit. Refer to Figure 3-1.

(20) Set the RANGE switch on the VTVM to the 10 V position and zero the meter.

(21) Leave the three numbered CHANNEL switches at 220.9 mc.

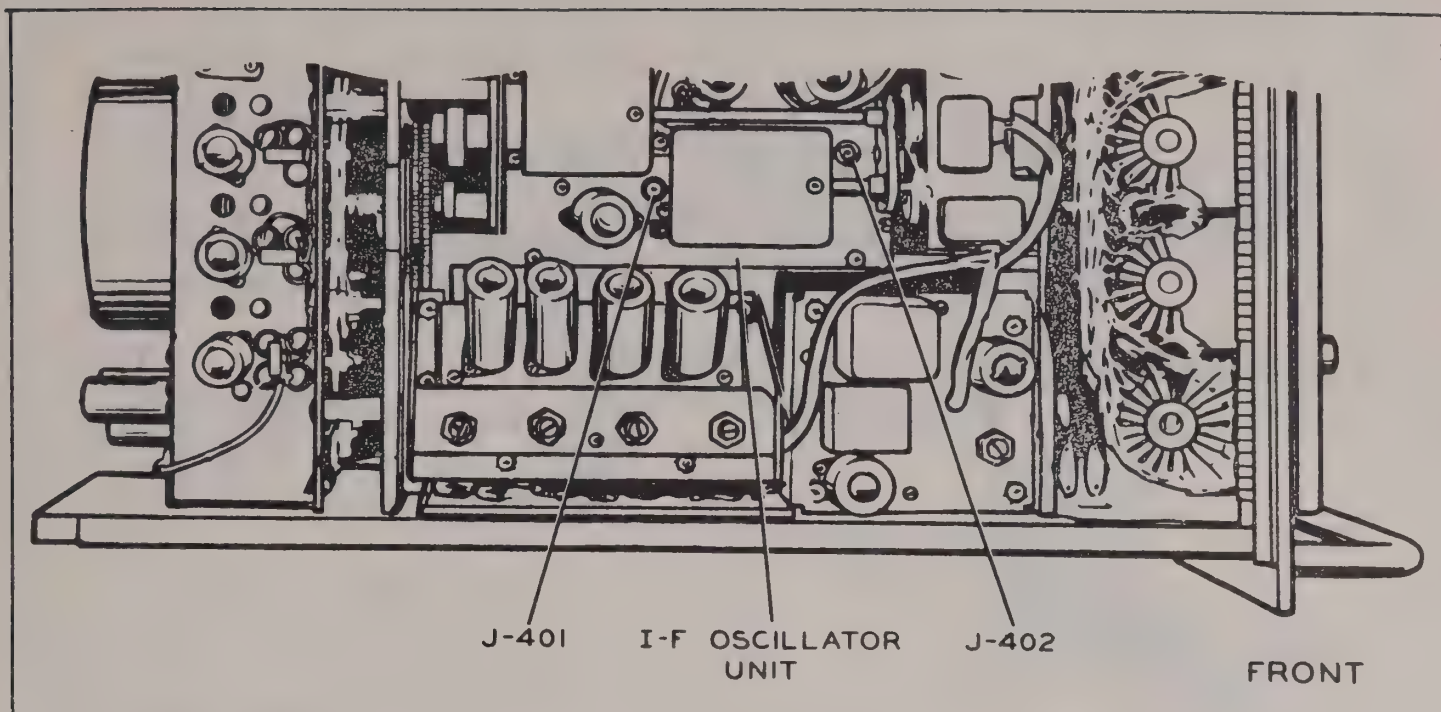


Figure 3-1 Radio Transmitter T-217A/GR, Partial Top View, Cover Removed

(22) Set the VOICE-MCW CARRIER ON switch to the MCW CARRIER ON position. The VTVM indication should be between 2 and 4 volts. If this reading is not obtained, alignment is indicated.

(23) Set the VOICE-MCW CARRIER ON switch to VOICE.

(24) Repeat Steps (22) and (23) at each of the following CHANNEL switch settings:

(a) 221.9 mc

(b) 222.9 mc

(c) 223.9 mc

(d) 224.9 mc

(e) 225.9 mc

(f) 226.9 mc

(g) 227.9 mc

(h) 228.9 mc

(i) 229.9 mc

(25) Disconnect the VTVM DC probe from J-402 and connect it to capacitor C-302 on the Frequency Multiplier-Amplifier Unit. See Figure 3-2.

(26) Set the VTVM RANGE switch to the 2 V position and zero the meter.

(27) Leave the three numbered CHANNEL switches at 229.9 mc.

(28) Set the VOICE-MCW CARRIER ON switch on the modulator to the MCW CARRIER ON position. The VTVM indication should be less than 0.4 volts. If the VTVM reading is less than 0.4 volts, alignment is indicated.

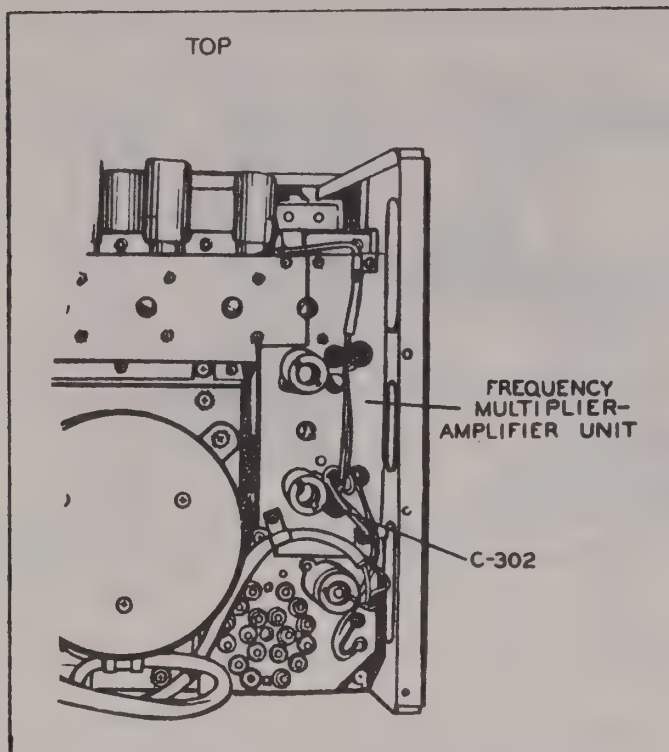


Figure 3-2 Radio Transmitter T-217A/GR, Partial Rear View, Cover Removed

(29) Set the VOICE-MCW CARRIER ON switch to the VOICE position.

(30) Repeat Steps (28) and (29) at each of the following CHANNEL switch settings:

- (a) 239.9 mc
- (b) 249.9 mc
- (c) 259.9 mc
- (d) 269.9 mc
- (e) 279.9 mc
- (f) 289.9 mc
- (g) 299.9 mc
- (h) 309.9 mc
- (i) 319.9 mc

- (j) 329.9 mc
- (k) 339.9 mc
- (l) 349.9 mc
- (m) 359.9 mc
- (n) 369.9 mc
- (o) 379.9 mc
- (p) 389.9 mc
- (q) 399.9 mc

(31) Disconnect the VTVM DC probe from C-302 and connect it to J-501 on the Driver Unit. See Figure 3-3.

(32) Set the VTVM RANGE switch to the 10 V position and zero the meter.

(33) Leave the three numbered CHANNEL switches at 399.9 mc.

(34) Set the VOICE-MCW CARRIER On switch on the modulator to the MCW CARRIER ON position. The VTVM indication should be no less than 1.5 volts. If the VTVM reading is less than 1.5 volts, alignment is indicated.

(35) Set the VOICE-MCW CARRIER ON switch to the VOICE position.

(36) Repeat Steps (34) and (35) at each of the following CHANNEL switch settings:

- (a) 225.0 mc

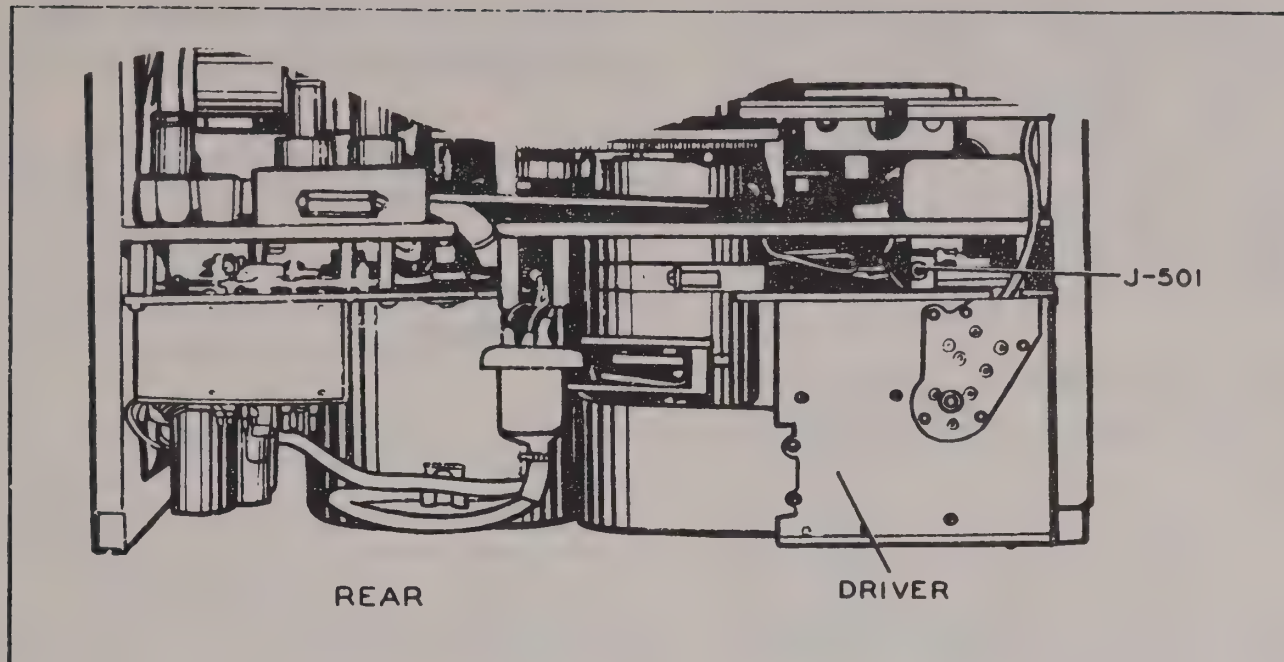


Figure 3-3 Radio Transmitter T-217A/GR, Partial Bottom View,  
Cover Removed

(b) 236.1 mc

(n) 358.3 mc

(c) 247.2 mc

(o) 369.4 mc

(d) 258.3 mc

(p) 370.5 mc

(e) 269.4 mc

(q) 381.6 mc

(f) 270.5 mc

(r) 392.7 mc

(g) 281.6 mc

(37) Disconnect the DC probe from J-501 on the Driver Unit and set the VTVM RANGE switch to 50 V.

(h) 292.7 mc

(i) 303.8 mc

(38) Connect the DC probe to J-1411 on the rear of the modulator. The VTVM indication should be between 30 and 40 volts. If the VTVM reading is abnormal, alignment is indicated.

(j) 314.9 mc

(k) 325.0 mc

(l) 336.1 mc

(39) Disconnect the DC probe from J-1411 and connect it to J-1412.

(m) 347.2 mc

(40) Set the VOICE-MCW CARRIER ON switch to the MCW CARRIER ON position. The VTVM indication should be between 33 and 45 volts. Any deviation from this reading indicates alignment is needed.

(41) Set the VOICE-MCW CARRIER ON switch to the VOICE position.

(42) Disconnect the DC probe from J-1412 and set the VTVM FUNCTION switch to AC and the RANGE switch to 10 V. Zero the meter.

(43) Connect the common lead of the VTVM to J-1409 on the rear of the modulator and connect the AC PROBE to J-1410. The reading should be between 6 and 6.4 volts. If the reading is less than 6 volts alignment is indicated.

(44) Remove the common and AC PROBE leads from J-1409 and J-1410 and set the VTVM FUNCTION switch to positive DC, the RANGE switch to 500 V, and zero the meter.

(45) Connect the VTVM common lead to chassis ground and the DC probe to capacitor C-1435. C-1435 is located in the center of the left side of the modulator. The VTVM indication should be between 350 and 380 volts.

(46) Set the VOICE-MCW CARRIER ON switch on the modulator to the MCW CARRIER ON position. The VTVM indication should be between 260 and 295 volts.

(47) Set the VOICE-MCW CARRIER ON switch to VOICE.

(48) Return the equipment to its original condition.

### 3-4 MECHANICAL SYNCHRONIZATION

#### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

#### a. TEST EQUIPMENT REQUIRED.

None

#### b. MATERIALS REQUIRED.

(1) Slot Screwdriver.

(2) Phillips Screwdriver.

#### c. PROCEDURE.

(1) Remove the modulator and the transmitter from the mounting rack, remove the dust cover from the transmitter, and place both units on a work bench.

(2) Pull the interlock switch on the transmitter to its full outward position.

(3) Connect a power cable from an a-c power source to the 115 V POWER receptacle on the modulator.

(4) Connect the cable from the large TRANSMITTER jack on the

modulator to the large receptacle on the front of the transmitter.

(5) Set the POWER ON-OFF switch on the modulator to the ON position.

(6) Set the CHANNEL SELECTOR on the transmitter to Channel 1.

(7) Set the three numbered CHANNEL switches on the transmitter to 390.5 mc on Channel 1.

(8) Observe the rotor bars through the access holes in the tuner of the Exciter Unit. The access holes over tuners Z-101 and Z-102 are shown in Figure 3-4. The rotor bars should be directly above the driven shaft as viewed from the top of the tuners.

(9) Set the three numbered CHANNEL switches on the transmitter to 300.5 mc on Channel 1.

(10) Observe the rotor bar through the access hole of Z-103 on the Exciter Unit. The access hole over Tuner Z-103 is shown in Figure 3-4. This rotor bar should be directly above the driven shaft as viewed from the top.

(11) Set the three numbered CHANNEL switches to 220.0 mc on Channel 1.

(12) Observe that the rotary switch tab is making connection with the right-hand clip on the Main Oscillator Unit. See Figure 3-5.

(13) Set the three numbered CHANNEL switches to 390.0 mc on Channel 1.

(14) Observe that the rotary switch tab is making connection with the left-hand clip on the Main Oscillator Unit. See Figure 3-5.

(15) Remove the rear plate from the transmitter by removing the Phillips head screws.

(16) Remove the three Phillips head screws holding the crystal oscillator oven cover and remove the oven cover. See Figure 3-5.

(17) Observe that the rotary switches are making contact with the 41.11111 mc crystal socket pins (Position No. 1).

(18) Replace the crystal oven cover and secure it with the Phillips head screws.

(19) Remove the six Phillips head screws from the Frequency Multiplier-Amplifier Unit side cover schematic plate and remove the plate.

(20) The shorting clip of the toroidal tuners should be on the smallest coil turn.

(21) The calibrated 10 MC GEAR DIAL in front of the Frequency Multiplier-Amplifier Unit should be indicating "39". See Figure 3-4.

(22) Observe the rotor bars through the access holes on the Frequency Multiplier-Amplifier Unit. These holes, as viewed from the top, reveal tuners Z-304, Z-306, and Z-308 as shown in Figure 3-4. The rotor bars in each of the tuners should be directly above the driven shaft as viewed from the top.

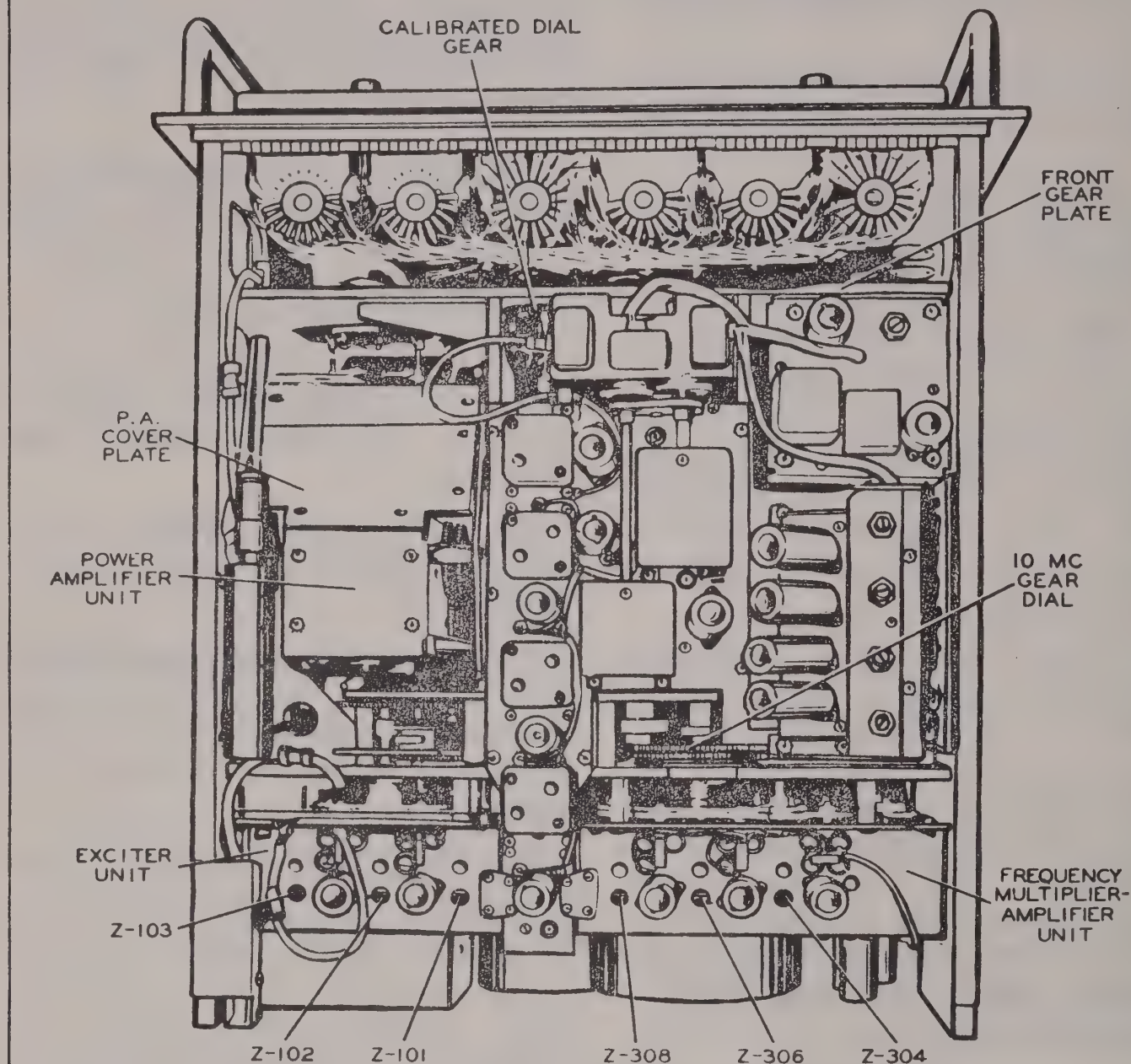


Figure 3-4 Radio Transmitter T-217A/GR, Top View, Cover Removed

(23) Replace the schematic cover plate on the Frquency Multiplier-Amplifier Unit.

(24) Observe the follower on the step cam as viewed from the bottom rear of the transmitter. Note that

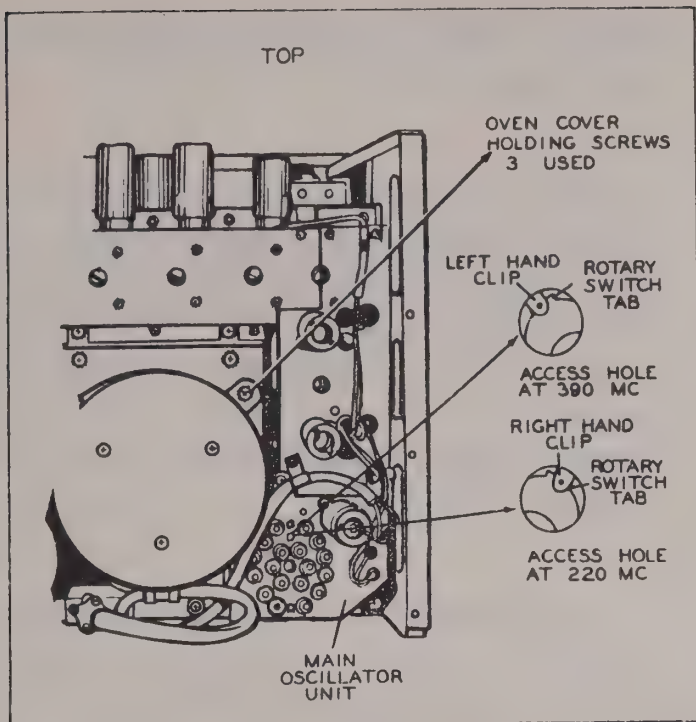


Figure 3-5 Radio Transmitter T-217A/GR, Partial Rear View, Cover Removed.

the follower is on the highest point of the step cam. See Figure 3-6.

(25) Locate the couplers behind the front panel as viewed from the bottom of the transmitter. These couplers are located between the Frequency Selector Unit and the front gear plate.

(26) The scribe lines on the couplers should be in line with the scribe lines on the adjacent blocks.

(27) The calibrated DIAL GEAR, located forward of the I-F Oscillator Unit, should read "0" as viewed from the top of the unit. See Figure 3-4.

(28) Loosen the screws in the Driver Unit access cover plates and slide the plates forward.

(29) Set up the three numbered CHANNEL switches on the transmitter to 360.5 mc on Channel 1.

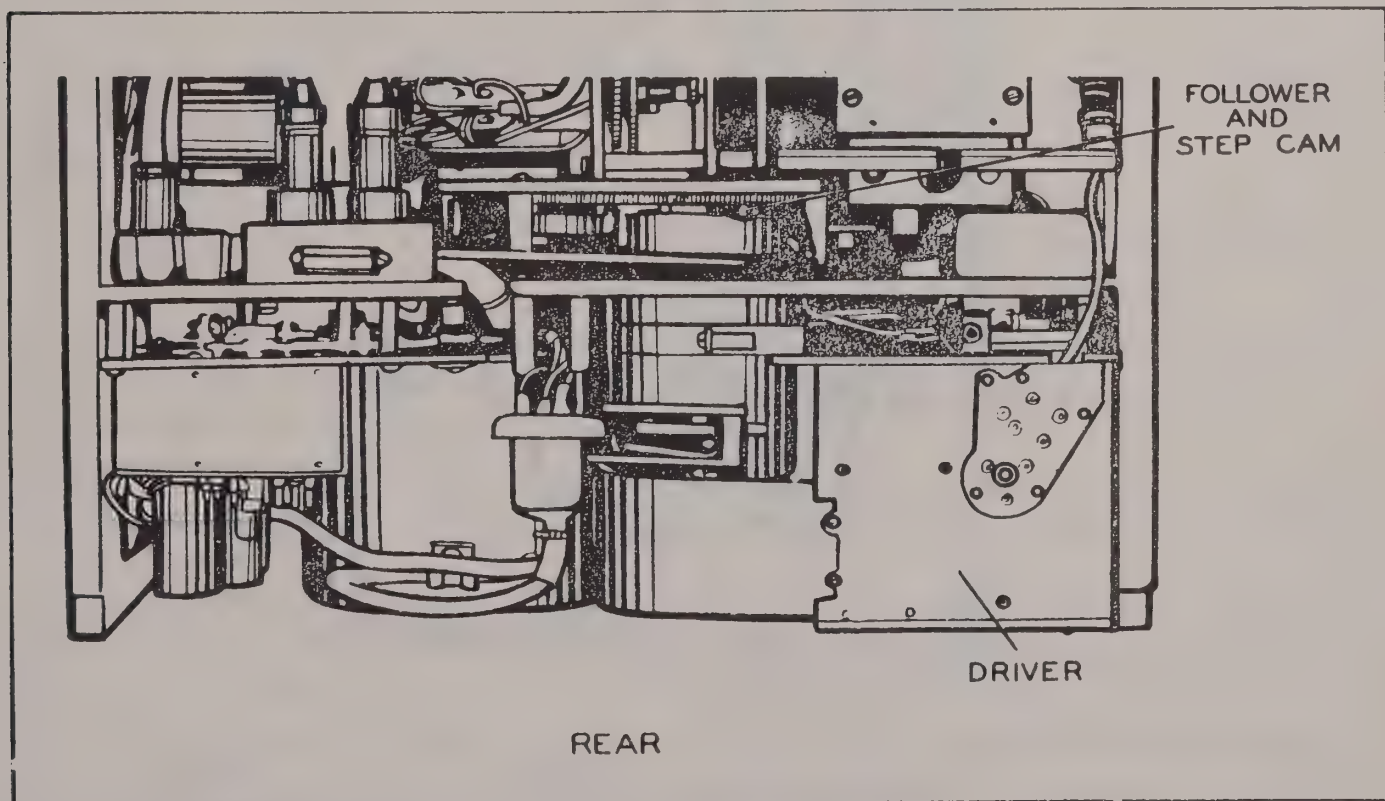


Figure 3-6 Radio Transmitter T-217A/GR, Partial Bottom View, Cover Removed.

(30) Viewing the rotor bar through the access holes on the Driver Unit, observe that the rotor bars in all three tuners are aligned with the capacitor stator short support bar.

(31) Replace the three driver unit access cover plates.

(32) Set the three numbered CHANNEL switches on the transmitter to 390.5 mc on Channel 1.

(33) Remove the six phillips head screws from the top slanted-cover

plate of the Power Amplifier Unit. See Figure 3-4.

(34) As viewed from the top front, locate the nearest set of shorting bar contacts. These contacts should be aligned to within 1/4 inch of the second set of support pins. The second set of support pins are the second pair away from the tube socket. See Figure 3-7.

(35) Replace the cover plate on the Amplifier Unit, and return the equipment to its original condition.

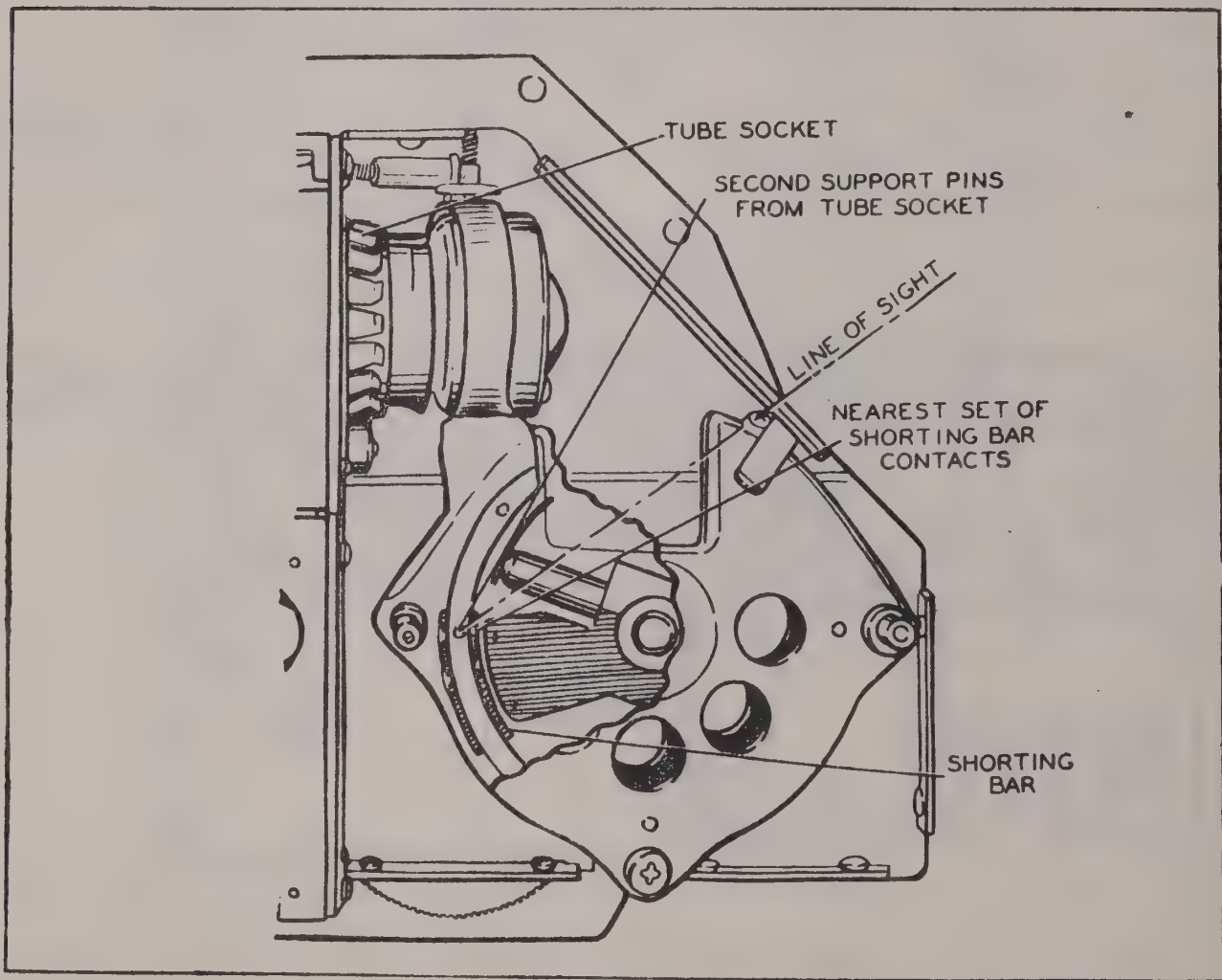


Figure 3-7 Radio Transmitter T-217A/GR, Power Amplifier Shorting Bar Positions at 390.5Mc.

### 3-5 MAIN OSCILLATOR ALIGNMENT (Transmitter).

#### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

#### a. TEST EQUIPMENT REQUIRED.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: $\pm 4\%$ , Range: 0-10 Volts.	TS-505( )/U or ME-25( )/U

#### b. MATERIALS REQUIRED.

- (1) Screwdriver, nonmetallic.
- (2) Dummy load. See Figure 3-8.
- (3) Slot Screwdriver.

#### c. PROCEDURE.

(1) Remove the modulator and the transmitter from the mounting rack, remove the dust cover from the transmitter, and place both units on a work bench.

(2) Pull the interlock switch on the rear of the transmitter to its full outward position.

(3) Connect a power cable from an a-c power source to the 115 V POWER receptacle on the front of the modulator.

(4) Connect the cable from the large TRANSMITTER jack on the modulator to the large jack on the front of the transmitter.

(5) Connect the dummy load to the small TRANSMITTER jack on the modulator. See Figure 3-8.

(6) Connect a coaxial cable between the OMNI. ANT. receptacle on the front of the transmitter and an antenna.

(7) Set the DIR. ANT.-CARRIER OFF-OMNI. ANT. control on the transmitter to the OMNI. ANT. position.

(8) Adjust and connect the VTVM as follows:

(a) Set the RANGE switch to 2 V, the FUNCTION switch to negative DC, and zero the meter.

(b) Connect the DC probe at TEST POINT C-302. See Figure 3-9.

(c) Connect the VTVM common lead to the transmitter chassis.

(9) Set the modulator POWER ON-OFF switch to the ON position.

(10) Align the oscillator coils as outlined below:

(a) Set the CHANNEL SELECTOR switch to Channel 1.

CONNECT LAMP BASES IN SERIES  
USING NO 18 AWG PLAIN COPPER  
WIRE WITH HIGH VOLTAGE INSULATION

40 W, 120 V  
LIGHT BULB  
.8 REQ'D

AN3108B-18-16P  
CONNECTOR

CERAMIC  
LAMP BASE  
(8 REQ'D)

Figure 3-8 Dummy Load for Modulator-Power Supply MD-129A/GR.

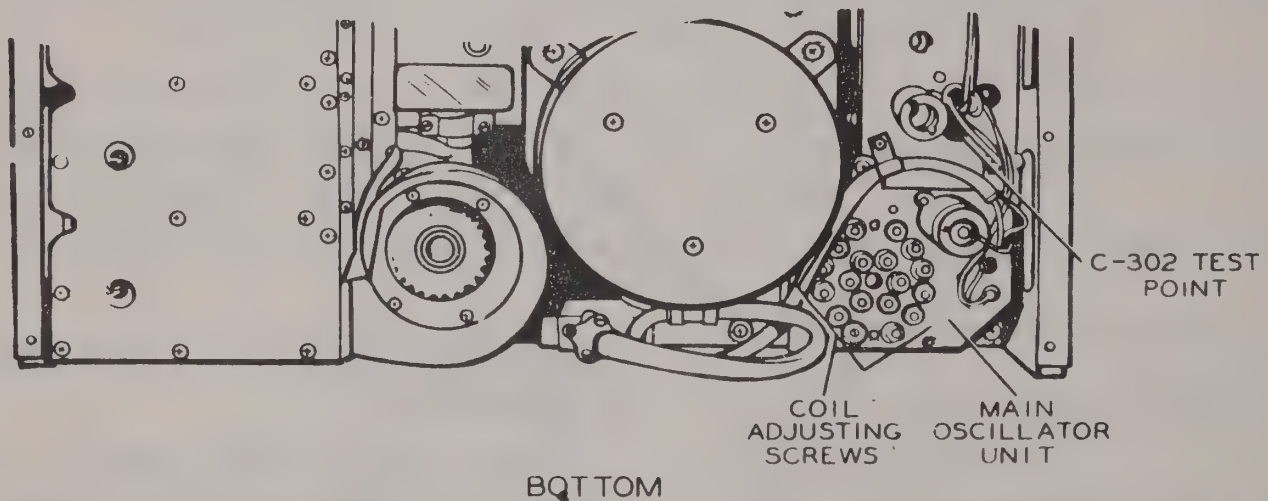


Figure 3-9 Radio Transmitter T-217A/GR, Partial Rear View, Cover Removed.

(b) Set the three numbered CHANNEL switches to 395.0 mc on Channel 1.

(c) Set the VOICE-MCW CARRIER ON switch on the modulator MCW CARRIER ON.

(d) Set the TRACKING CONTROL switch to NORMAL.

(e) Turn the coil adjusting screw numbered 39, all the way in flush with the stud slot, and then back it out until the VTVM indicates a maximum reading.

(f) Set the TRACKING CONTROL from NORMAL to OFF and back to NORMAL. The VTVM indication should return. If the reading returns, proceed to Step (h). If the

reading does NOT return, perform Step (g).

(g) Turn the coil adjusting screw in a counterclockwise direction until the meter reading returns, then turn the screw 1/8 turn counterclockwise.

(h) Set the TRACKING CONTROL to OFF and the VOICE-MCW CARRIER ON switch to VOICE.

(11) Set the three numbered CHANNEL switches to the frequencies listed below and adjust the corresponding adjusting screws by repeating Steps (10)(c) thru (10)(h) above.

- (a) 385.0 mc, screw number 38.
- (b) 375.0 mc, screw number 37.
- (c) 365.0 mc, screw number 36.
- (d) 355.0 mc, screw number 35.
- (e) 345.0 mc, screw number 34.
- (f) 335.0 mc, screw number 33.
- (g) 325.0 mc, screw number 32.
- (h) 315.0 mc, screw number 31.

- (i) 305.0 mc, screw number 30.
- (j) 295.0 mc, screw number 29.
- (k) 285.0 mc, screw number 28.
- (l) 275.0 mc, screw number 27.
- (m) 265.0 mc, screw number 26.
- (n) 255.0 mc, screw number 25.
- (o) 245.0 mc, screw number 24.
- (p) 235.0 mc, screw number 23.
- (q) 225.0 mc, screw number 22.

(12) Turn the equipment OFF and return it to its original condition.

3-6 FREQUENCY MULTIPLIER-AMPLIFIER ALIGNMENT

CAUTION

The following procedures shall be performed by personnel at the THIRD ECHELON OF MAINTENANCE or higher.

a. TEST EQUIPMENT REQUIRED.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: ±4%, Range: 0-10 Volts	TS-505( )/U or ME-25( )/U

## b. MATERIALS REQUIRED.

(1) Screwdriver, nonmetallic.

(2) Slot Screwdriver.

(3) Tuning Wand. See Figure 3-10.

(4) Dummy Load. See Figure 3-8.

(5) Sector Bending Tool, made from a blunt scribe with the sides ground flat.

(6) R-F Cable, RG-58/U or equivalent.

(7) Phillips Screwdriver.

## c. PROCEDURE.

(1) Remove the modulator and the transmitter from the mounting rack, remove the transmitter dust cover, and place both units on a work bench.

(2) Pull the interlock switch on the rear of the transmitter to its full outward position.

(3) Connect an a-c power cable from an a-c outlet to the 115 V POWER receptacle on the front of the modulator.

(4) Connect a cable from the large TRANSMITTER jack on the modulator to the large jack on the front of the transmitter.

(5) Connect the dummy load to the small TRANSMITTER jack on the modulator.

(6) Connect the coaxial cable between the OMNI. ANT. connector on the front of the transmitter and an antenna.

(7) Adjust and connect the VTVM as follows:

(a) Set the FUNCTION switch to negative DC, the RANGE switch to 2 V, and zero the meter.

(b) Connect the DC probe to TEST POINT C-308. See Figure 3-11.

(c) Connect the VTVM common lead to the transmitter chassis.

(8) Set the modulator POWER ON-OFF switch to ON and the METER SELECTOR switch to OFF.

(9) Remove the phillips head screws from the Frequency Multiplier-Amplifier Unit end cover plate but leave the plate in place.

(10) Align the Z-301 and Z-302 circuits in the following manner:

(a) Set the three numbered CHANNEL switches to 300.0 mc on Channel 1, and position the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(b) With the nonmetallic screwdriver, adjust Z-301 trimmer, see Figure 3-11, until the VTVM indicates maximum, and set the VOICE-MCW CARRIER ON switch to VOICE.

(c) Set the three numbered CHANNEL switches to 390.0 mc on Channel 1, and set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

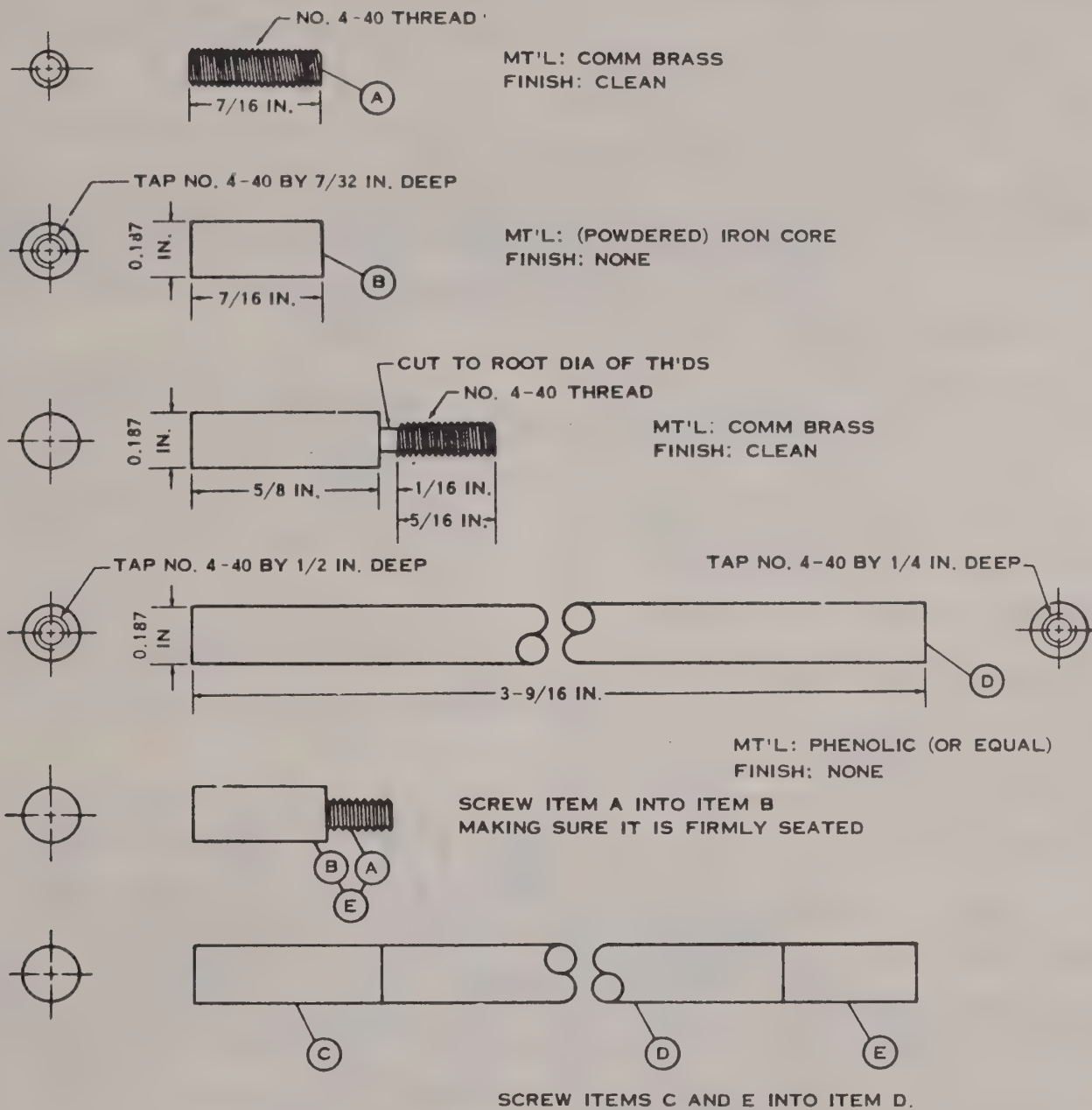


Figure 3-10 Tuning Wand Fabrication Details.

(d) Slide the end cover plate upward enough to insert first the brass end and then the iron end of the tuning wand close to the coil visible under the cover plate. Observe the VTVM indication.

(e) If the meter reading increased when the brass end was inserted, set the TRACKING CONTROL switch to OFF and stretch the coil turns farther apart.

(f) If the meter reading increased when the iron end was inserted, set the TRACKING CONTROL switch to OFF and press the coils together very slightly.

(g) Repeat Steps (a) through (f) above until no further increase is obtained in the VTVM reading.

(h) Disconnect the DC probe of the VTVM from C-308, set the RANGE switch to 25 V, and connect the DC probe to TEST POINT C-315. See Figure 3-12.

(i) Set the VOICE-MCW CARRIER ON switch to VOICE and set the three numbered CHANNEL switches to 300.0 mc on Channel 1.

(j) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON and with a nonmetallic screwdriver, adjust trimmer Z-302 until the VTVM indicates maximum. See Figure 3-11.

(k) Set the VOICE-MCW CARRIER ON switch to VOICE and set the three numbered CHANNEL switches to 390.0 mc on Channel 1.

(l) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON and slide the end cover plate upward enough to insert first the brass end and then the iron end of the tuning wand close to the Z-302 coil. Observe the VTVM indication.

(m) If the VTVM reading increased when the brass end was inserted, set the TRACKING CONTROL switch to OFF and stretch the coil turns farther apart.

(n) If the VTVM indication increased when the iron end was inserted, set the TRACKING CONTROL switch to OFF and press the coil turns together very slightly.

(o) Repeat Steps (i) through (n) above until the VTVM indicates no further increase in reading.

(11) Replace the end cover plate.

(12) Tune the Z-304, Z-306 and Z-308 trimmers as follows:

(a) Disconnect the DC probe from C-315 and connect it to J-403. See Figure 3-12.

(b) Set the VOICE-MCW CARRIER ON switch to VOICE and set the three numbered CHANNEL switches to 360.5 mc on Channel 1.

(c) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON and adjust trimmers Z-304, Z-306, and Z-308 until the VTVM

indicates a maximum reading. See Figure 3-11.

# NOTE

(13) Align the Z-304, Z-306, and Z-308 tuning capacitors in the manner outlined below:

The tuning capacitors consist of two stator plates and three rotor plates. The front and rear rotor plates are radially

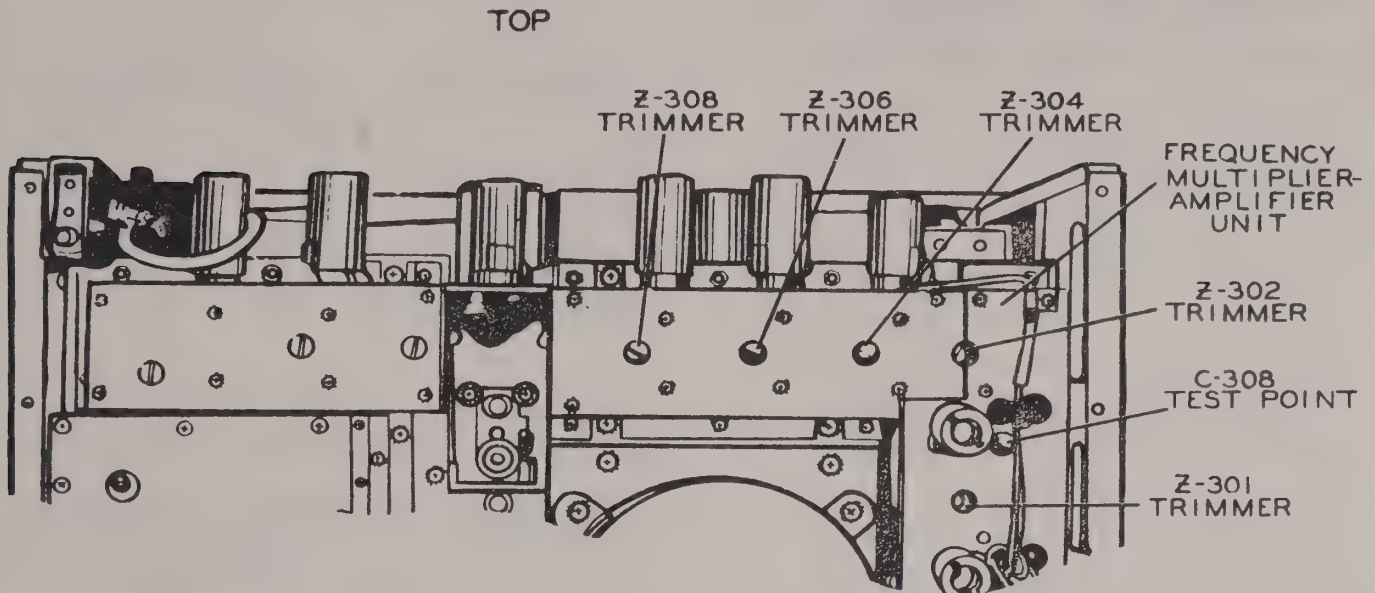


Figure 3-11 Radio Transmitter T-217A/GR, Partial Rear View, Cover Removed.

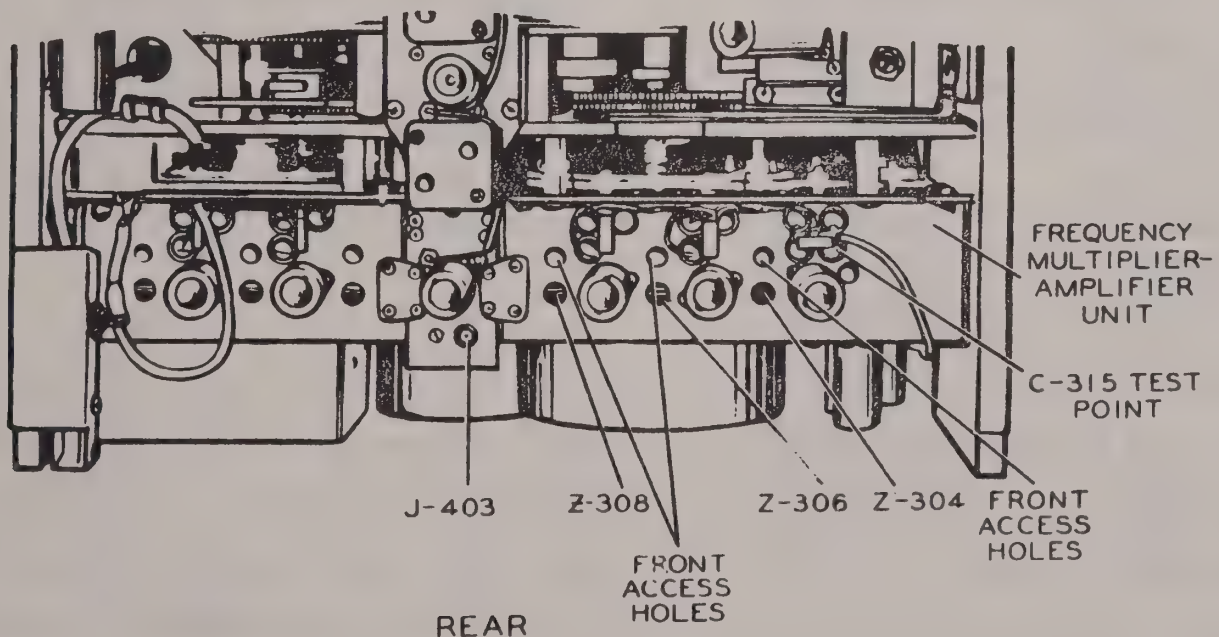


Figure 3-12 Radio Transmitter T-217A/GR, Partial Top View, Cover Removed.

slotted into sectors which can be bent closer to or farther away from the next stator plates. See Figure 3-13. These plates are visible in the Z-304, Z-306, and Z-308 rear access holes. The tuning capacitors are aligned by bending the front or rear sectors which are half engaged at the frequency under consideration.

In order to locate the proper sector, each sector is numbered and color coded. In order that the proper sector can be reached in the access hole, the TRACKING CONTROL switch must be set to RUN long enough to drive the gear behind the 10 mc Indicator Dial so that the proper letter or number on the gear lines up with the mark on the dial. Table 3-2 lists the sector color code, the number, and also the dial position for each setting of the CHANNEL switches.

360.5 mc is the tuner tracking point, at which there is no sector. At 370.5 mc, bending the capacitor sector is usually ineffective, and a check at this frequency will only show whether the trimmer setting at 360.5 was sufficiently accurate.

(a) Set the VOICE-MCW CARRIER ON switch to VOICE and set the three numbered CHANNEL switches to 380.5 mc on Channel 1.

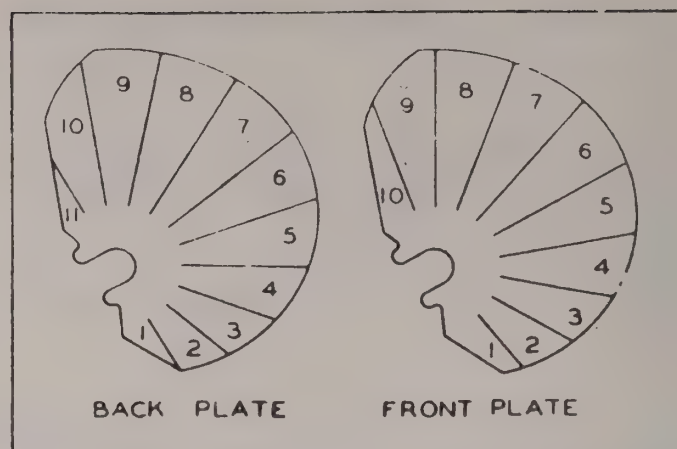


Figure 3-13 Radio Transmitter T-217A/GR, Frequency Multiplier-Amplifier Unit, Tuner Capacitor Sector.

(b) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON and test each tuner Z-304, Z-306, and Z-308 by inserting first the brass end and then the iron end of the tuning wand into the front access hole. See Figure 3-12. Observe the VTVM indication while inserting the tuning wand.

(c) If the VTVM reading decreased when both the brass and the iron ends were inserted in the front access holes of the three tuners, the tuners are properly aligned and no adjustment is necessary.

(d) If insertion of the brass end of the tuning wand into any of the access holes increases the VTVM reading, operate the TRACKING CONTROL switch to RUN until the 10-mc dial gear indicator points to J. Observe that the front sector, number 10, (plain in color) is accessible through the access hole of the r-f tuner. Bend sector number 10 AWAY FROM the stator plate

slightly. Return the TRACKING CONTROL switch to NORMAL and observe the VTVM indication while inserting the brass end of the tuning wand. The VTVM indication will decrease if the adjustment was sufficient.

(e) If insertion of the iron end of the wand into any of the r-f tuners causes an increased VTVM reading, operate the TRACKING CONTROL switch to RUN until the 10-mc dial gear indicator points to

J. Bend the front sector, number 10, TOWARD the stator plate slightly. Return the TRACKING CONTROL switch to NORMAL and observe the VTVM indication while inserting the iron end of the tuning wand into the access hole. The VTVM indication will decrease if the adjustment was sufficient.

(f) Repeat steps (a) thru (e) at each of the frequencies listed in Table 3-2. See Figures 3-12 and 3-13.

TABLE 3-2. Frequency Multiplier-Amplifier Alignment Points.

CHANNEL SWITCH SETTING	INDICATOR DIAL POSITION	SECTOR	
		NUMBER*	COLOR
390.5 mc	I	10 BACK	BLACK
380.5 mc	J	10 FRONT	PLAIN
370.5 mc	None	None	None
350.5 mc	29	2 BACK	RED
340.5 mc	28	2 FRONT	RED
330.5 mc	27	3 BACK	BLUE
320.5 mc	26	3 FRONT	BLUE
310.5 mc	25	4 BACK	YELLOW
300.5 mc	24	4 FRONT	YELLOW
290.5 mc	23	5 BACK	BLACK
280.5 mc	22	5 FRONT	BLACK
270.5 mc	A	6 BACK	PLAIN
260.5 mc	B	6 FRONT	RED
250.5 mc	C	7 BACK	RED
240.5 mc	D	7 FRONT	BLUE
230.5 mc	E	8 BACK	BLUE
220.5 mc	F	8 FRONT	YELLOW

\*BACK indicates rotor plate next to ceramic end plate.  
FRONT indicates rotor plate toward drive shaft.

## NOTE

There may be interaction between tuners so that when one sector is bent in any particular tuner, the other two may or may not remain aligned. There will be interaction between adjacent sectors of the same tuner so that close tracking can be accomplished only if the entire alignment procedure is repeated at least once.

(14) Return the equipment to its original condition.

### 3-7 I-F OSCILLATOR ALIGNMENT

#### CAUTION

The following procedures shall be performed by personnel at the THIRD ECHELON OF MAINTENANCE or higher.

#### a. TEST EQUIPMENT REQUIRED.

(2) Slot Screwdriver.

(3) Tuning wand. See Figure 3-10.

(4) Dummy Load. See Figure 3-8.

(5) Sector bending tool, made from a blunt scribe with the sides ground flat.

(6) 6-inch machinist's scale.

(7) Soldering iron.

#### c. PROCEDURE.

(1) Remove the modulator and the transmitter from the mounting rack, remove the dust cover from the transmitter, and place both units on a work bench.

(2) Pull the interlock switch on the rear of the transmitter to its full outward position.

(3) Connect a power cable from an a-c outlet to the 115 V POWER

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: $\pm 4\%$ , Range: 0-10 Volts	TS-505( )/U or ME-25( )/U

#### b. MATERIALS REQUIRED.

receptacle on the front of the modulator.

(1) Screwdriver nonmetallic. See Figure 3-24.

(4) Connect the cable from the large TRANSMITTER jack on the

modulator to the large jack on the front of the transmitter.

(5) Connect the dummy load to the small TRANSMITTER jack on the modulator.

(6) Connect a coaxial cable between the OMNI. ANT. receptacle on the front of the transmitter and an antenna.

(7) Set the DIR. ANT.-CARRIER OFF-OMNI. ANT. switch on the transmitter to the OMNI. ANT. position, the CHANNEL SELECTOR to 1, and the Meter Selector to POWER OUTPUT-WATTS.

(8) Adjust and connect the VTVM in the following manner:

(a) Set the RANGE switch to 4 V, the FUNCTION switch to negative DC, and zero the meter.

(b) Connect the DC probe to J-402 as shown in Figure 14.

(c) Connect the VTVM common lead to the transmitter chassis.

(9) Set the modulator POWER ON-OFF switch to ON and the METER SELECTOR to OFF.

(10) Set the three numbered CHANNEL switches on the transmitter to 399.9 mc on Channel 1.

(11) Mark the nonmetallic screwdriver 1-7/32 inches from the screwdriver end.

(12) With the nonmetallic screwdriver, adjust slugs L-403, L-404,

L-405, L-406, L-407, L-408, and L-409 until the mark on the screwdriver is even with the top of the shielding cans. See Figure 3-14.

(13) Using a nonmetallic screwdriver, set capacitors C-408, C-417, C-424, C-436, and C-447 so that the silvered portion of the variable sections are vertical. These capacitors are accessible at the sides of the shielding cans. A right-angle tuning tool may be required to adjust these capacitors.

#### NOTE

The fixed portion of the capacitors are at the top of the can assemblies. With the variable portion vertical, the capacitors will be set at half capacitance.

(14) Remove tubes V-305 and V-101. See Figure 3-14.

(15) Insert the brass end of the tuning wand into L-403. Leave the tuning wand inserted throughout Step (16).

(16) Tune Z-401 circuit as follows:

(a) Set the three numbered CHANNEL switches to 390.0 mc on Channel 1.

(b) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(c) Using a nonmetallic screwdriver, adjust the L-405 slug until the VTVM reading is maximum.

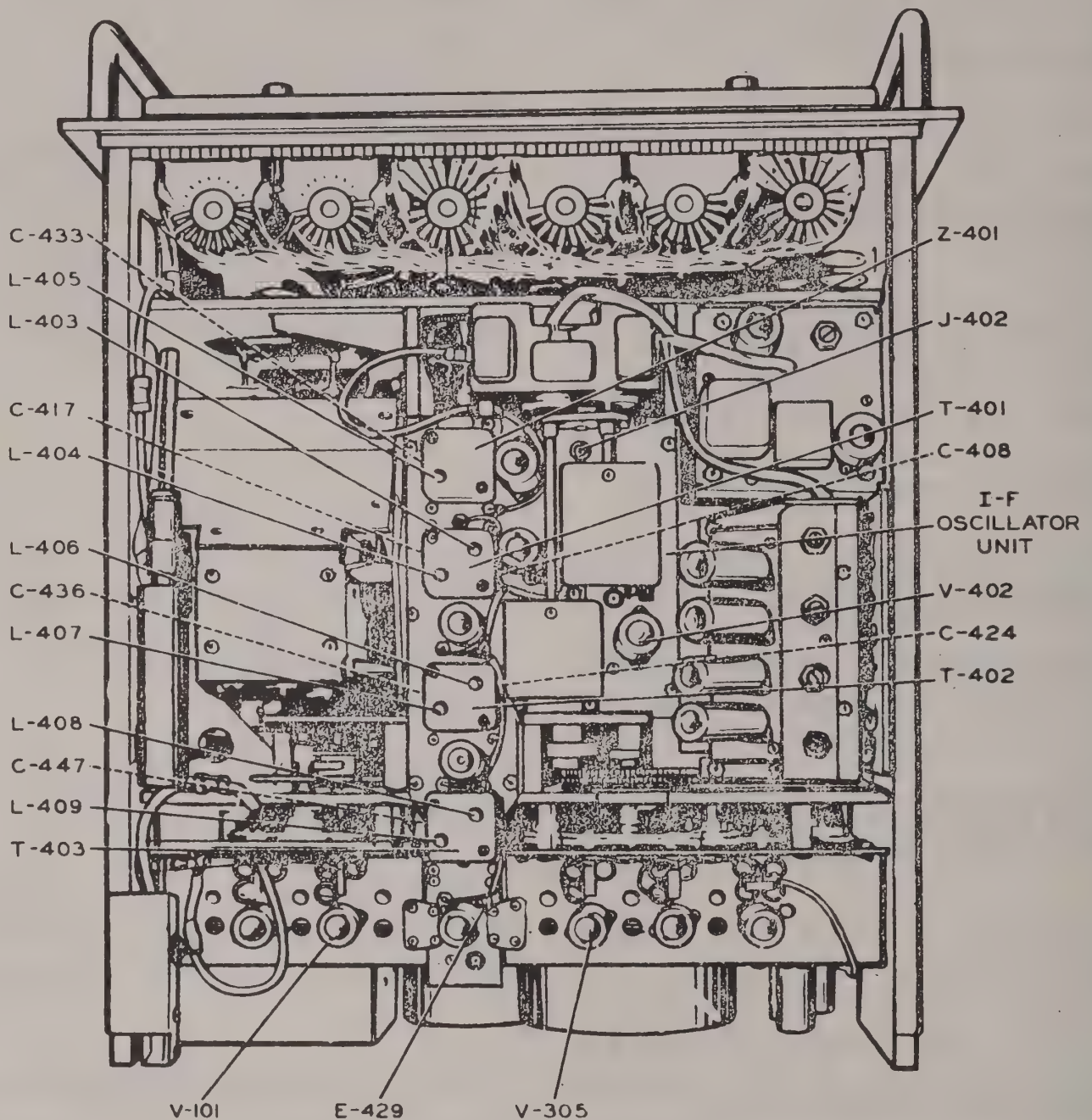


Figure 3-14 Radio Transmitter T-217A/GR, Top View, Cover Removed

Two peaks may be observed during this step. A later check will determine if the proper one was chosen.

(d) Set the VOICE-MCW CARRIER ON switch to VOICE.

(e) Set the three numbered CHANNEL switches to 399.9 mc on Channel 1.

(f) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(g) With a nonmetallic screwdriver, adjust capacitor C-433 for a maximum VTVM indication.

(h) Repeat Steps (a) through (g) above until no further increase can be obtained on the VTVM.

(i) Set the VOICE-MCW CARRIER ON switch to VOICE and remove the tuning wand from L-403.

(17) Tune circuits T-401, T-402, and T-403 as follows:

(a) Set the TRACKING CONTROL switch OFF and disconnect the white with red tracer lead from E-429 and insulate the exposed end of the lead. See Figure 3-14.

(b) Connect the DC probe of the VTVM to J-403.

(c) Set the three numbered CHANNEL switches to 399.0 mc and position the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(d) With a nonmetallic screwdriver, adjust C-408, C-417, C-424, C-436, C-443, and C-447 (in that order) for a maximum VTVM indication.

(e) Remove the V-402 from its socket. If the transformers are

tuned correctly, the VTVM indication will drop to zero. This step checks Step (16)(c). Replace V-402 after performing this step.

(f) Set the VOICE-MCW CARRIER ON switch to VOICE.

(g) Set the three numbered CHANNEL switches to 390.0 mc on Channel 1.

(h) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(i) Using a nonmetallic screwdriver, adjust L-403, L-404, L-406, L-407, L-408, and L-409 (in that order) for a maximum VTVM indication.

(j) Repeat Steps (c) through (j) above until no further increase can be obtained on the VTVM.

(18) Repeat Steps (15) and (16) substituting the frequencies listed below instead of the frequency given in Step (16)(a).

(a) 391.0 mc

(b) 392.0 mc

(c) 393.0 mc

(d) 394.0 mc

(e) 395.0 mc

(f) 396.0 mc

(g) 397.0 mc

(h) 398.0 mc

## NOTE

The VTVM indications should remain nearly constant during the performance of Step (18) above.

(19) Reconnect lead to E-429.

(20) Return the equipment to its original condition.

## 3-8 EXCITER ALIGNMENT

### CAUTION

The following procedures shall be performed by personnel at the THIRD ECHELON OF MAINTENANCE or higher.

#### a. TEST EQUIPMENT REQUIRED.

(5) Sector bending tool, made from a blunt scriber with the sides ground flat.

(6) Small screwdriver, slot.

#### c. PROCEDURE.

(1) Remove the modulator and the transmitter from the mounting rack, remove the dust cover from the transmitter, and place both units on a work bench.

(2) Pull the interlock switch on the rear of the transmitter to its full outward position.

(3) Connect a power cable from an a-c outlet to the 115 V POWER receptacle on the front of the modulator.

(4) Connect the cable from the large TRANSMITTER jack on the

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: $\pm 4\%$ , Range: 0-10 Volts.	TS-505( )/U or ME-25( )/U

#### b. MATERIALS REQUIRED.

(1) Screwdriver, nonmetallic.

(2) Slot screwdriver.

(3) Tuning wand. See Figure 3-10.

(4) Dummy load. See Figure 3-8.

front of the modulator to the large receptacle on the front of the transmitter.

(5) Connect the dummy load to the small TRANSMITTER jack on the front of the modulator.

(6) Connect a coaxial cable between the OMNI. ANT. connector on the transmitter and an antenna.

(7) Set the DIR. ANT.-CARRIER OFF-OMNI. ANT. switch to the OMNI. ANT. position.

(8) Adjust and connect the VTVM as follows:

(a) Set the FUNCTION switch to negative DC, the RANGE switch to 4 V, and zero the meter.

(b) Connect the DC probe to J-501 on the Driver Unit. See Figure 3-15.

(c) Connect the VTVM common lead to the transmitter chassis.

(9) Set the modulator POWER ON-OFF switch to ON and the METER SELECTOR switch to OFF.

(10) Set the transmitter METER SELECTOR switch to POWER OUTPUT-WATTS and the CHANNEL SELECTOR to 1.

(11) Set the three numbered CHANNEL switches on the trans-

mitter to 360.5 mc on Channel 1.

(12) Set the TRACKING CONTROL switch to OFF.

(13) Loosen the coupler which links the rear gear train and the Exciter Unit drive gear. The Exciter Unit drive gear is the one nearest the rear gear plate.

#### CAUTION

Do NOT move the gear train while decoupling the Exciter Unit.

(14) Set the TRACKING CONTROL switch to NORMAL and set the three numbered CHANNEL switches to 380.5 mc on Channel 1.

(15) Remove tube V-405 from its socket.

(16) Set the VOICE-MCW CARRIER ON switch on the modulator to MCW CARRIER ON.

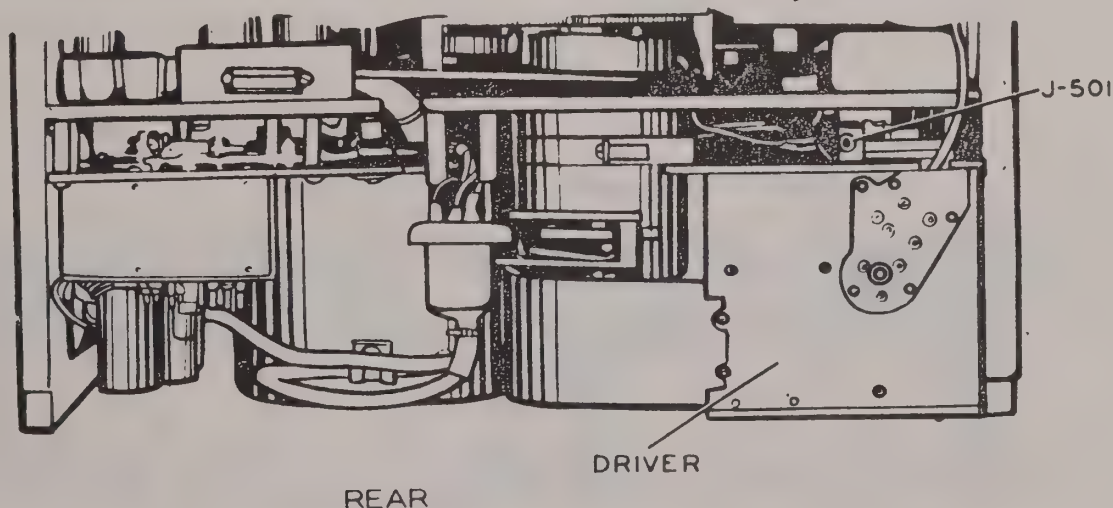


Figure 3-15 Radio Transmitter T-217A/GR, Partial Bottom View, Cover Removed.

(17) Using a nonmetallic screwdriver, adjust trimmers Z-101, Z-102, and Z-103 until the reading on the VTVM is maximum. See Figure 3-16.

(18) Set the VOICE-MCW CARRIER ON switch to VOICE.

(19) Set the three numbered CHANNEL switches to 360.5 mc and set the TRACKING CONTROL switch to OFF. DO NOT allow the Exciter Unit drive gear to move during the channeling from 380.5 to 360.5 mc.

(20) Recouple the gear train to the Exciter Unit drive gear.

(21) Replace V-405 in its socket and set the TRACKING CONTROL switch to NORMAL.

(22) Repeat Steps (16), (17) and (18).

(23) Align tuning capacitors in Z-101, Z-102, and Z-103 circuits as outlined in the following steps:

#### NOTE

The tuning capacitors consist of two stator plates and three rotor plates. The front and rear rotor plates are radially slotted into sectors which can be bent closer to or farther away from the next stator plates. See Figure 3-17. These plates are visible through the Z-101, Z-102, and Z-103 rear access holes. The tuning capacitors are aligned by bending the front or rear sectors which are half engaged at the frequency under consideration.

In order to locate the proper sector, each sector is numbered and color coded. In order that the proper sector can be reached in the access hole, the TRACKING CONTROL switch must be set to RUN long enough to drive the gear behind the 10-mc Indicator Dial so that the proper

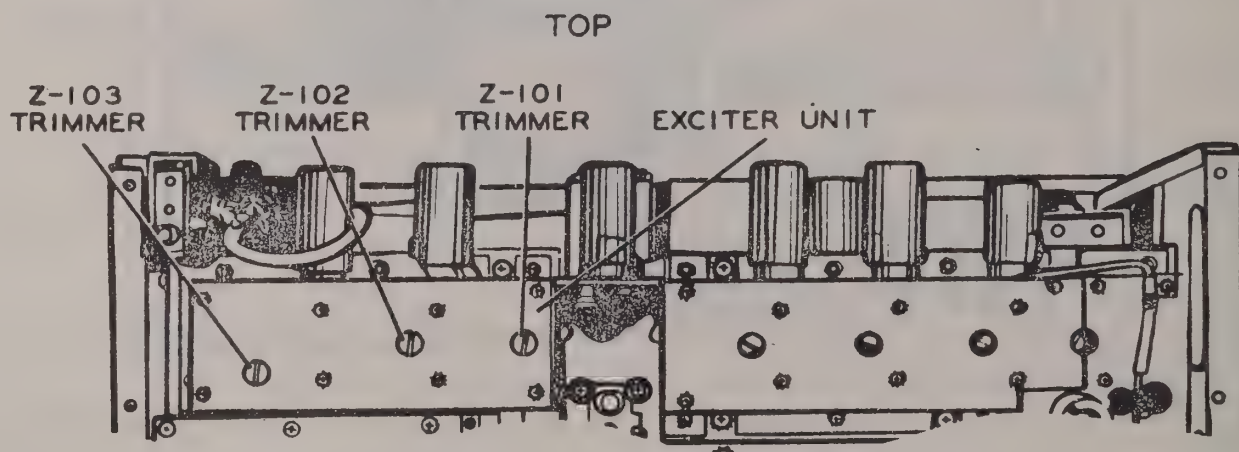


Figure 3-16 Radio Transmitter T-217A/GR, Partial Rear View, Cover Removed.

number or letter on the gear lines up with the mark on the dial. Table 3-3 lists the sector color code, the number, and also the dial position for each setting of the CHANNEL switches.

360.5 mc is the tuner tracking point, at which there is no sector. At 370.5 mc, bending the capacitor sector is usually ineffective, and a check at this frequency will only show whether the trimmer setting was sufficiently accurate at the 360.5 mc setting.

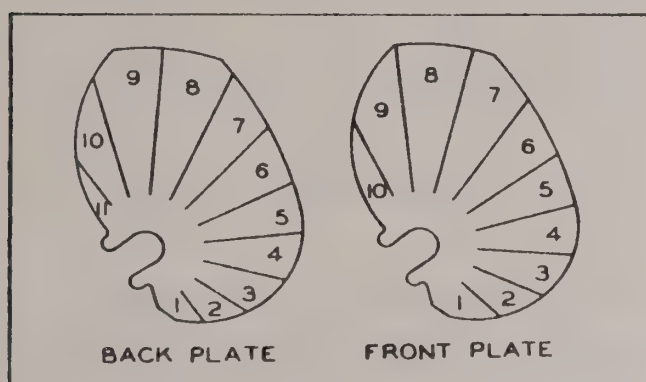


Figure 3-17 Radio Transmitter T-217A/GR, Exciter Unit, Tuner Capacitor Sectors.

(a) Set the VOICE-MCW CARRIER ON switch on the modulator to VOICE and set the three numbered CHANNEL switches to 380.5 mc on Channel 1.

(b) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON and test each tuner by inserting first the brass end and then the iron end of the tuning wand into the front access holes. Observe the VTVM indication while inserting the tuning wand.

(c) If the VTVM reading decreased when both the brass and the iron end of the tuning wand were inserted, the tuners are properly aligned and no adjustment is necessary.

(d) If insertion of the brass end of the tuning wand into either Z-101 or Z-102 increased the VTVM reading, operate the TRACKING CONTROL switch to RUN until the 10-mc dial gear indicator points to L. Observe that the front sector, number 10, (plain in color) is accessible through the access hole of Z-101 and Z-102. Bend sector number 10 AWAY FROM the sector plate slightly. Return the TRACKING CONTROL switch to NORMAL and observe the VTVM reading while inserting the brass end of the tuning wand. The VTVM indication will decrease if the adjustment was sufficient.

(e) If insertion of the brass end of the tuning wand into Z-103 causes an increase in the VTVM reading, operate the TRACKING CONTROL switch to RUN until the 10-mc dial gear indicator points to 37. Observe that the front sector, number 10, (plain in color) is accessible through the access hole of Z-103. Bend sector number 10 AWAY FROM the stator plate slightly. Return the TRACKING CONTROL switch to NORMAL and observe the meter reading while inserting the iron end of the wand into Z-103. The meter indication will decrease if the adjustment was sufficient.

(f) If insertion of the iron end of the tuning wand into either Z-101 or

Z-102 causes an increased VTVM reading, operate the TRACKING CONTROL switch to RUN until the 10-mc dial gear indicator points to L. Bend the front sector, number 10, TOWARD the stator plate slightly. Return the TRACKING CONTROL switch to NORMAL and observe the VTVM indicator while inserting the iron end of the wand into Z-101 and Z-102. The VTVM reading will decrease if the adjustment was sufficient.

## NOTE

There may be interaction between the tuners so that when one sector is bent in any particular tuner, the other two may be affected. There will be interaction between sectors of the same tuner so that accurate tracking can be accomplished only if the whole procedure is repeated at least once.

(g) If insertion of the iron end of the wand into Z-103 causes an increased VTVM reading, operate the TRACKING CONTROL switch to RUN until the 10 mc dial gear indicator points to 37. Bend the front sector, number 10, TOWARD the stator plate slightly. Return the TRACKING CONTROL switch to NORMAL and observe the VTVM reading while inserting the iron end of the wand into Z-103. The VTVM indication will decrease if the adjustment was sufficient.

(24) Turn the equipment off and return it to its original condition.

## 3-9 DRIVER ALIGNMENT.

### CAUTION

The following procedures shall be performed by personnel at the THIRD ECHELON OF MAINTENANCE or higher.

(h) Repeat Steps (a) thru (g) at each of the frequencies listed in Table 3-3.

### a. TEST EQUIPMENT REQUIRED.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
VTVM	DC Sensitivity: 13 M Ohms/V; Accuracy: $\pm 4\%$ , Range: 0-20 Volts.	TS-505( )/U or ME-25( )/U
RF Watt-meter	Range: 200-400 Mc; Power Capability: 2-60 Watts; Z: 51.5 Ohms	AN/URM-43( )

TABLE 3-3. Exciter Alignment Points

CHANNEL SWITCH SETTINGS (MC)	INDICATOR DIAL POSITION		SECTOR	
	FOR Z-101 AND Z-102	FOR Z-103	NUMBER*	COLOR
399.5	J	39	9-FRONT	BLACK
390.5	K	38	10-BACK	BLACK
380.5	L	37	10-FRONT	PLAIN
370.5	NONE	NONE	NONE	NONE
350.5	28	C	1-FRONT	PLAIN
340.5	27	D	2-BACK	RED
330.5	26	E	2-FRONT	RED
320.5	25	F	3-BACK	BLUE
310.5	24	G	3-FRONT	BLUE
300.5	23	H	4-BACK	YELLOW
290.5	22	I	4-FRONT	YELLOW
280.5	A	J	5-BACK	BLACK
270.5	B	K	5-FRONT	BLACK
260.5	C	L	6-BACK	PLAIN
250.5	D	M	6-FRONT	RED
240.5	E	N	7-BACK	RED
230.5	F	O	7-FRONT	BLUE
220.5	G	P	8-BACK	BLUE

\*BACK indicates rotor plate next to ceramic end plate.

FRONT indicates rotor plate toward drive shaft.

#### b. MATERIALS REQUIRED.

(1) Slug Puller. See Figure 3-18  
(3 required).

(2) Slot Screwdriver.

(3) Thin screwdriver, narrow  
enough to fit through the slug puller  
hole (7/64 wide max.).

(4) Tuning Wand. See Figure  
3-10.

(5) Dummy Load. See Figure  
3-8.

(6) Sector Bending Tool, made  
from a blunt scriber with the sides  
ground flat.

#### c. PROCEDURE.

(1) Remove the modulator and  
the transmitter from the mounting  
rack, remove the dust cover from  
the transmitter, and place both units  
on a work bench.

(2) Pull the interlock switch on  
the transmitter to its full outward  
position and place the unit on its  
left side as viewed from the front.

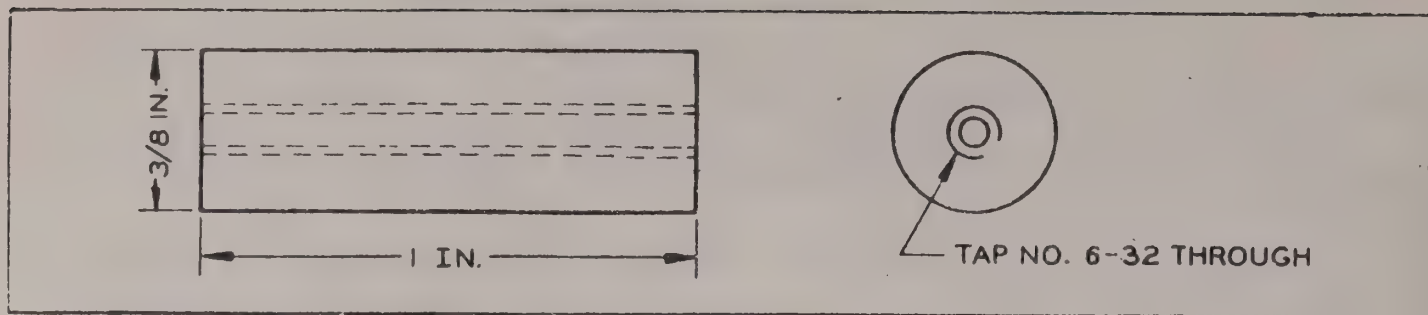


Figure 3-18 Slug Puller Fabrication Details.

(3) Connect a power cable from an a-c outlet to the modulator 115 V POWER receptacle.

(4) Connect the cable from the large TRANSMITTER jack on the front of the modulator to the large jack on the front of the transmitter.

(5) Connect the dummy load to the small TRANSMITTER jack on the front of the modulator.

(6) Connect a coaxial cable between the OMNI. ANT. receptacle on the transmitter and an antenna.

(7) Set the DIR. ANT.-CARRIER OFF-OMNI. ANT. switch on the transmitter to the OMNI. ANT. position.

(8) Adjust and connect the VTVM in the manner given below:

(a) Set the RANGE switch to 10 V, the FUNCTION switch to negative DC, and zero the meter.

(b) Connect the DC probe to J-501 and connect the VTVM common lead to the transmitter chassis.

(9) Set the modulator POWER ON-OFF switch to ON and the METER SELECTOR switch to OFF.

(10) Set the transmitter METER SELECTOR switch to POWER OUTPUT-WATTS and the CHANNEL SELECTOR to 1.

(11) Set the three numbered CHANNEL switches on the transmitter to the frequencies listed in Table 3-4 (220.0 mc first on Channel 1).

(12) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON. The VTVM should indicate from 1.6 volts to 4.8 volts.

(13) Repeat Steps (11) and (12) for those frequencies listed in Table 3-4.

TABLE 3-4. Driver Input Voltage Check

CHANNEL SWITCH SETTING	METER INDICATION
220.0 mc	1.6 to 4.8 volts

TABLE 3-4. Driver Input Voltage  
Check—Cont.

CHANNEL SWITCH SETTING	METER INDICATION
280.0 mc	2.4 to 7.8 volts
320.0 mc	2.4 to 8.2 volts
399.9 mc	1.2 to 4.0 volts

(14) Set the VOICE-MCW CARRIER ON switch to VOICE and disconnect the VTVM test leads from the equipment.

(15) Prepare the equipment for alignment as follows:

(a) Set the TRACKING CONTROL to OFF.

(b) Disconnect plug P-502 from the Power Amplifier Unit. See Figure 3-19.

(c) Connect the plug P-502 to the input of the RF wattmeter.

(d) Set the TRACKING CONTROL switch to NORMAL.

(16) Install the slug pullers on trimmer screws Z-501, Z-502, and Z-503 as follows: See Figure 3-20.

(a) Slip a thin screwdriver through the hole in the slug puller.

(b) Insert the blade of the screwdriver into the trimmer screw slot.

(c) Prevent the trimmer screw from turning and turn the slug puller onto the screw about two turns.

(17) Align slugs and trimmers Z-501, Z-502, and Z-503 as follows:

(a) Set the three numbered CHANNEL switches to 360.5 mc on Channel 1.

(b) Set the modulator VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(c) Adjust the trimmers until a maximum indication is obtained on the RF wattmeter.

(d) Push or pull on the slug pullers until the RF wattmeter indicates a maximum.

(e) With the thin screwdriver, adjust the trimmer screws in Z-501, Z-502 and Z-503 for a peak indication on the RF wattmeter.

(f) Set the VOICE-MCW CARRIER ON switch to VOICE.

(18) Align the Z-501 r-f tuning capacitors as described in the following steps:

#### NOTE

The tuning capacitors consist of two stator plates and three rotor plates. The front and rear rotor plates are radially

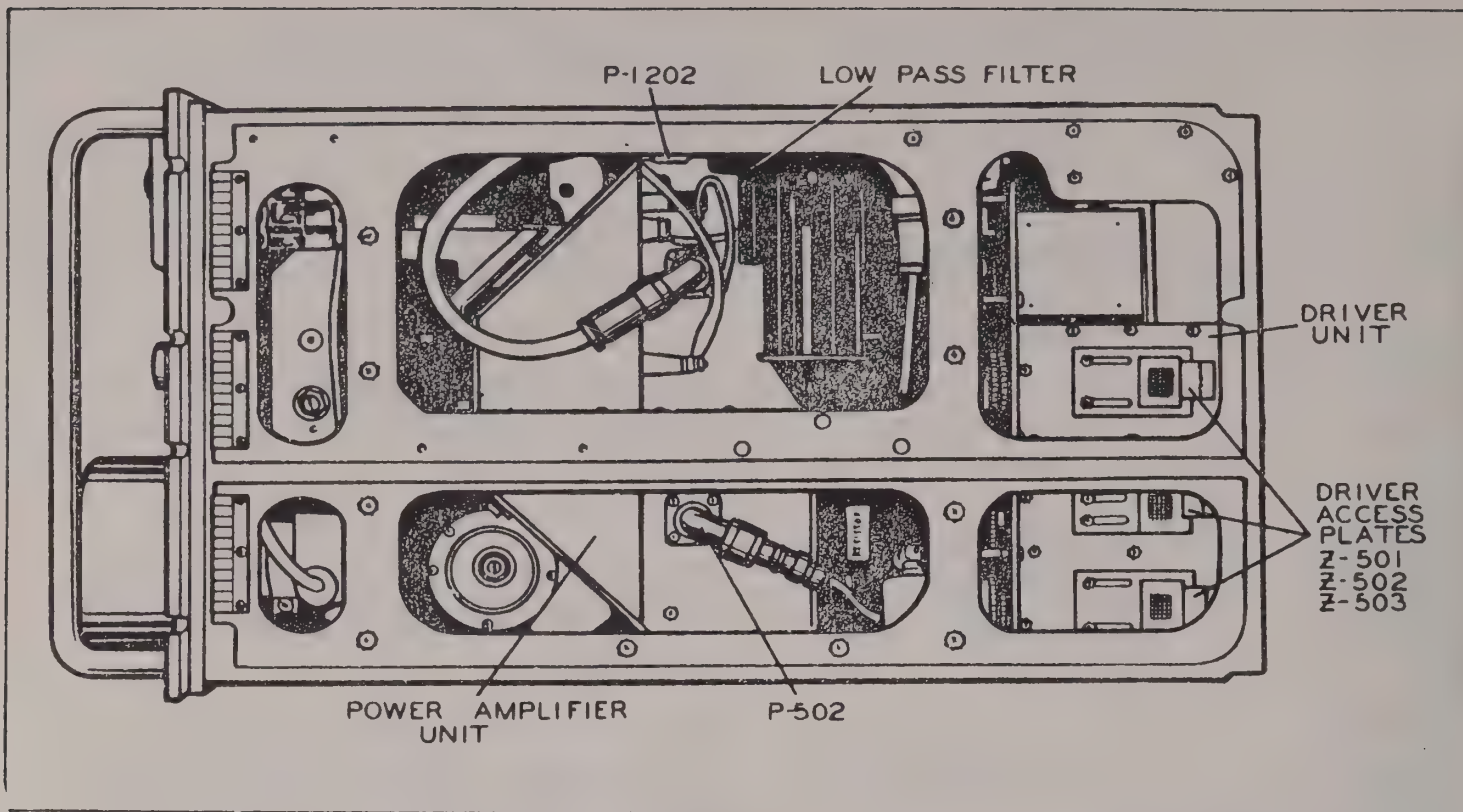


Figure 3-19 Radio Transmitter T-217A/GR, Right Side View,  
Cover Removed.

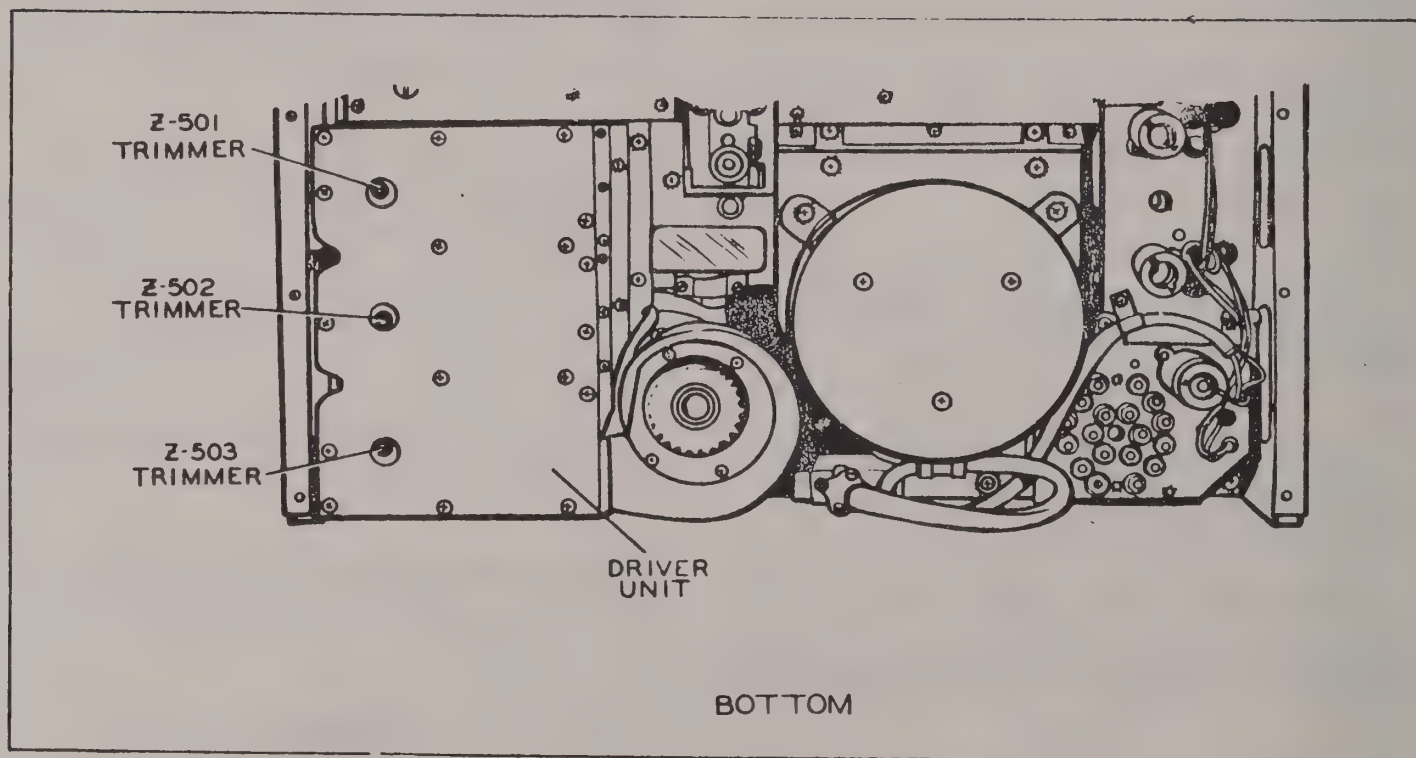


Figure 3-20 Radio Transmitter T-217A/GR, Partial Rear View,  
Cover Removed.

slotted into sectors which can be bent closer to or farther away from the next stator plates for tuning purposes. Figure 3-21 illustrates the Driver Unit tuning capacitor sectors. These plates are located behind the driver access plates shown in Figure 3-19. The tuning capacitors are aligned by bending the front or rear sector which is half engaged at the frequency under consideration.

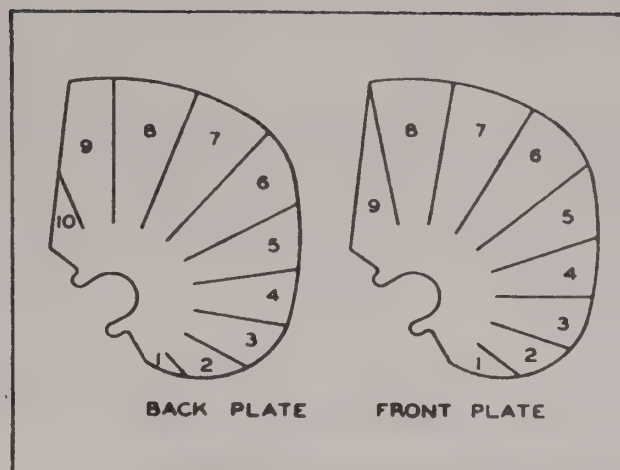


Figure 3-21 Radio Transmitter T-217A/GR, Driver Unit, Tuner Capacitor Sectors

In order to locate the proper sector, each sector is numbered and color coded. In order that the proper sector can be reached behind the driver access plate, the TRACKING CONTROL switch must be set to RUN long enough to drive the gear behind the 10-mc Indicator Dial so that the proper number on the gear lines up with the mark on the dial. Table 3-5 lists the sector color code, the number, and also the dial position for each setting of the CHANNEL switches.

360.5 mc is the tuner tracking point, at which there is no sector. At 370.5 mc, bending of the capacitor sector is usually ineffective, and a check at this frequency will only show whether the trimmer setting was sufficiently accurate at 360.5 mc.

(a) Loosen the screws which hold the driver access plate in place. Do not remove the plate.

(b) Set the three numbered CHANNEL switches on the transmitter to 380.5 mc on Channel 1, and set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(c) Observe the RF wattmeter reading and slowly push or pull the slug puller attached to Z-501. If the RF wattmeter reading decreases when either pushing or pulling the slug puller, the Z-501 tuner is properly aligned. Proceed to Step (1).

(d) If the RF wattmeter reading increased on either side of the slug puller original setting, proceed to Step (e).

(e) Set the slug puller to the point at which the RF wattmeter reading is maximum.

(f) Set the VOICE-MCW CARRIER ON switch to the VOICE position and slide the Z-501 access cover plate open.

(g) Set the TRACKING CONTROL switch to RUN until the 10-mc dial gear indicator points to 29 and return the switch to OFF.

(h) If the RF wattmeter reading increased when the slug puller was pushed in, bend the rear sectors, number 10 (plain in color), slightly CLOSER TO the capacitor stator plate.

(i) If the RF wattmeter reading increased when the slug puller was pulled out, bend the rear sector, number 10 (plain in color), AWAY FROM the capacitor stator plate.

(j) Slide the access cover plate closed, set the TRACKING CONTROL switch to NORMAL, and set the VOICE-MCW CARRIER ON switch to the MCW CARRIER ON position.

(k) Repeat Steps (c) through (j) above until the RF wattmeter indicates a decreased reading.

(l) Set the VOICE-MCW CARRIER ON switch to VOICE and repeat Steps (b) through (k) above

for each of the frequencies listed in Table 3-5.

(19) Align the Z-502 r-f tuning capacitor as follows:

(a) Set the three numbered CHANNEL switches to 360.5 mc on Channel 1 and position the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(b) Perform Steps (18)(a) thru (18)(l) above except tune the Z-502 slug instead of Z-501 slug. Substitute the applicable sector number, color, and dial position information from Table 3-5.

(20) Align the Z-503 r-f tuning capacitor as follows:

(a) Set the three numbered CHANNEL switches on the transmitter to 360.5 mc on Channel 1 and set the modulator VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(b) Perform Steps (18)(a) thru (18)(l) above except tune the Z-503 instead of Z-501 slug. Substitute the applicable sector number, color, and dial position information from Table 3-5.

(21) With the thin screwdriver inserted through the slug puller hole, prevent the slug screws from turning while removing the slug pullers.

(22) Return the equipment to its original position.

TABLE 3-5. Driver Alignment Points

CHANNEL SWITCH SETTING	INDICATOR DIAL POSITION	SECTOR	
		NUMBER*	COLOR
399.5 mc	31	9-BACK	BLACK
390.5 mc	30	9-FRONT	BLACK
380.5 mc	29	10-BACK	PLAIN
370.5 mc	NONE	NONE	NONE
350.5 mc	L	1-FRONT	PLAIN
340.5 mc	M	2-BACK	RED
330.5 mc	N	2-FRONT	RED
320.5 mc	O	3-BACK	BLUE
310.5 mc	P	3-FRONT	BLUE
300.5 mc	Q	4-BACK	YELLOW
290.5 mc	R	4-FRONT	YELLOW
280.5 mc	39	5-BACK	BLACK
270.5 mc	38	5-FRONT	BLACK
260.5 mc	37	6-BACK	RED
250.5 mc	36	6-FRONT	RED
240.5 mc	35	7-BACK	BLUE
230.5 mc	34	7-FRONT	BLUE
220.5 mc	33	8-BACK	YELLOW

\*BACK indicates rotor plate next to ceramic plate.

FRONT indicates rotor plate toward drive shaft.

### 3-10 SERVO SYSTEM ALIGNMENT

#### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

#### a. TEST EQUIPMENT REQUIRED.

None

#### b. MATERIALS REQUIRED.

- (1) Slot Screwdriver.
- (2) Microphone.
- (3) Dummy Load, see Figure 3-8.

#### c. PROCEDURE.

- (1) Remove the modulator and the transmitter from the mounting

rack, remove the dust cover from the transmitter, and place both units on a test bench.

(2) Pull the interlock switch on the transmitter to its full outward position.

(3) Connect a power cable from the 115 V POWER connector on the modulator to an a-c outlet.

(4) Connect the cable from the large TRANSMITTER jack on the modulator to the large jack on the front of the transmitter.

(5) Connect the dummy load to the small TRANSMITTER jack on the front of the modulator.

(6) Connect a coaxial cable from the OMNI. ANT. jack on the transmitter to an antenna.

(7) Set the DIR. ANT.-CARRIER OFF-OMNI. ANT. switch on the

transmitter to the OMNI. ANT. position.

(8) Set the transmitter CHANNEL SELECTOR to 1, the METER SELECTOR switch to P.A. GRID, and the three numbered CHANNEL switches to 390.2 mc on Channel 1.

(9) Turn the modulator POWER ON-OFF switch to ON.

(10) The following steps describe the alignment procedure for the Servo Amplifier Unit.

(a) Loosen the coupler between the servo gear train and the Power Amplifier gear train by first removing the servo schematic plate. Use caution so as not to disturb the mechanical position of the Power Amplifier gear train when loosening the coupler.

(b) Set resistors R-704, R-708, R-709, and R-712 as described in Table 3-6. See Figure 3-22.

TABLE 3-6. Servo Amplifier Resistor Settings

RESISTOR	SETTING
R-704	Turn fully counterclockwise; then turn clockwise about 60 degrees.
R-708	Set fully counterclockwise.
R-709	Turn fully counterclockwise; then turn clockwise about 50 degrees.
R-712	Turn fully counterclockwise; then turn clockwise about 135 degrees.

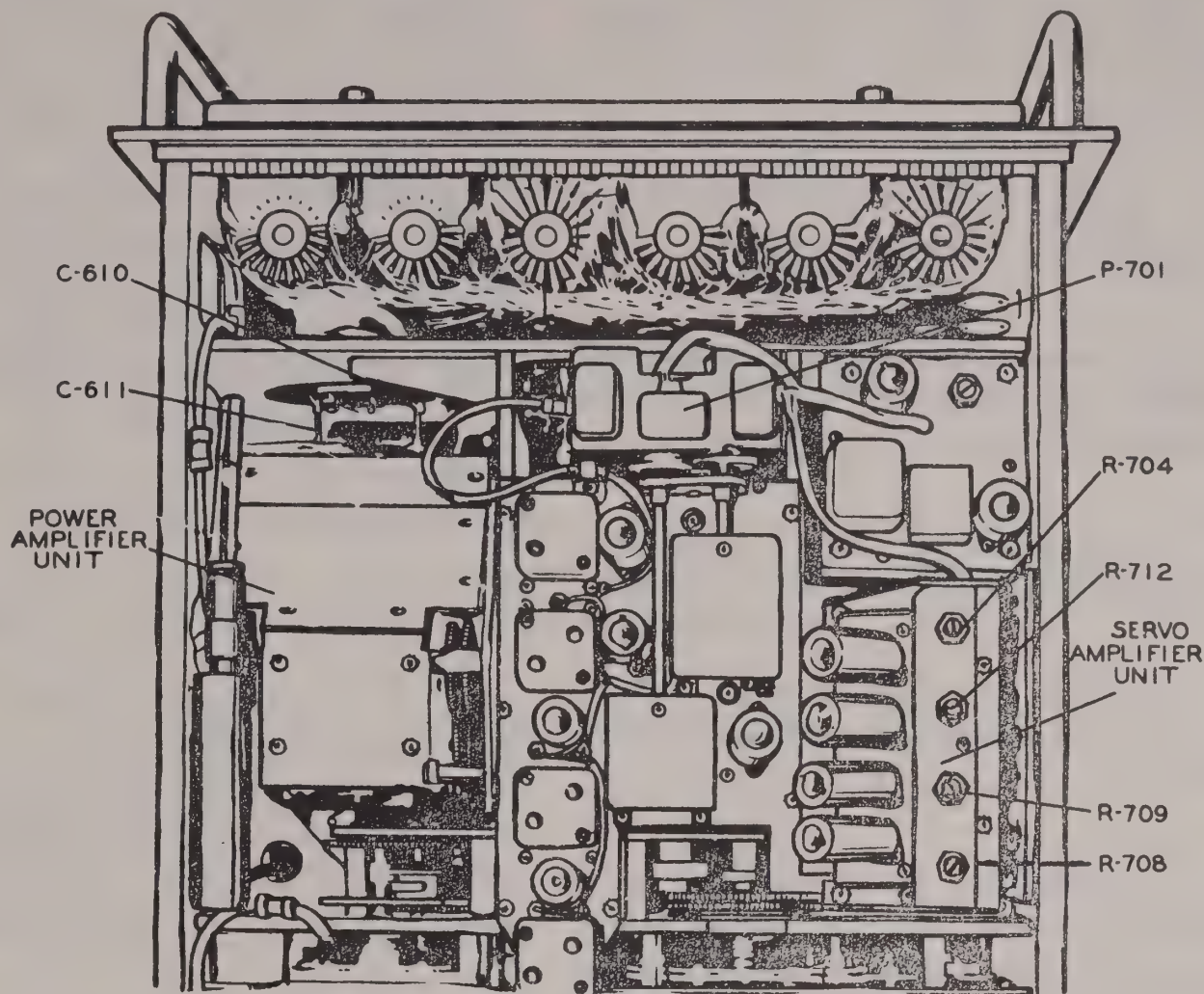


Figure 3-22 Radio Transmitter T-217A/GR, Partial Top View, Cover Removed.

(c) Set the TRACKING CONTROL switch from NORMAL to RUN and back to NORMAL.

(d) Set the modulator VOICE-MCW CARRIER ON switch to MCW CARRIER ON. The Servo Amplifier Unit should hunt.

(e) Turn R-708 clockwise until the hunting stops.

#### NOTE

Too much movement of R-708 will result in sluggish operation while not enough will

cause excessive hunting before settling down. The correct adjustment is that which requires the least movement of R-708.

(f) Set the VOICE-MCW CARRIER ON switch to the VOICE position.

(g) Set the three numbered CHANNEL switches to 390.2 mc on Channel 1.

(h) Tighten the coupler between the servo gear train and the Power Amplifier gear train.

(11) Synchronize the Servo Amplifier Unit with the Power Amplifier Unit as outlined in the following steps:

(a) Set all the wiper arms on R-1205 to a vertical position.

(b) Set the three numbered CHANNEL switches on the transmitter to 360.2 mc on Channel 1.

(c) Remove the Servo Amplifier Plug P-701.

(d) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(e) Manually turn the two thin driving gears on the servo drive until the transmitter panel meter indicates maximum PA GRID current. Set the VOICE-MCW CARRIER ON switch to VOICE.

(f) Remove the schematic plate and loosen coupler between the servo gear train and the Power Amplifier gear train.

(g) Reconnect the Servo Amplifier plug (P-701) and allow the servo system to reposition. (Allow sufficient warmup time for Servo Amplifier).

(h) Recouple the Servo Drive to the Power Amplifier gear train and replace the cover plate.

(i) Set the three numbered CHANNEL switches on the transmitter to the first frequency (220.2 mc) given in Table 3-7.

(j) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON and adjust R-1205 wiper number 220 until the transmitter panel meter reads maximum PA GRID current.

(k) Set the VOICE-MCW CARRIER ON switch to VOICE.

(l) Set up the three CHANNEL switches for each of the frequencies given in Table 3-7. Each time a new frequency is set up, set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON and adjust the appropriate R-1205 wiper for a maximum panel meter reading. See Figure 3-23.

(12) Return the equipment to its original condition.

### 3-11 POWER AMPLIFIER ALIGNMENT

#### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

#### a. TEST EQUIPMENT REQUIRED.

None

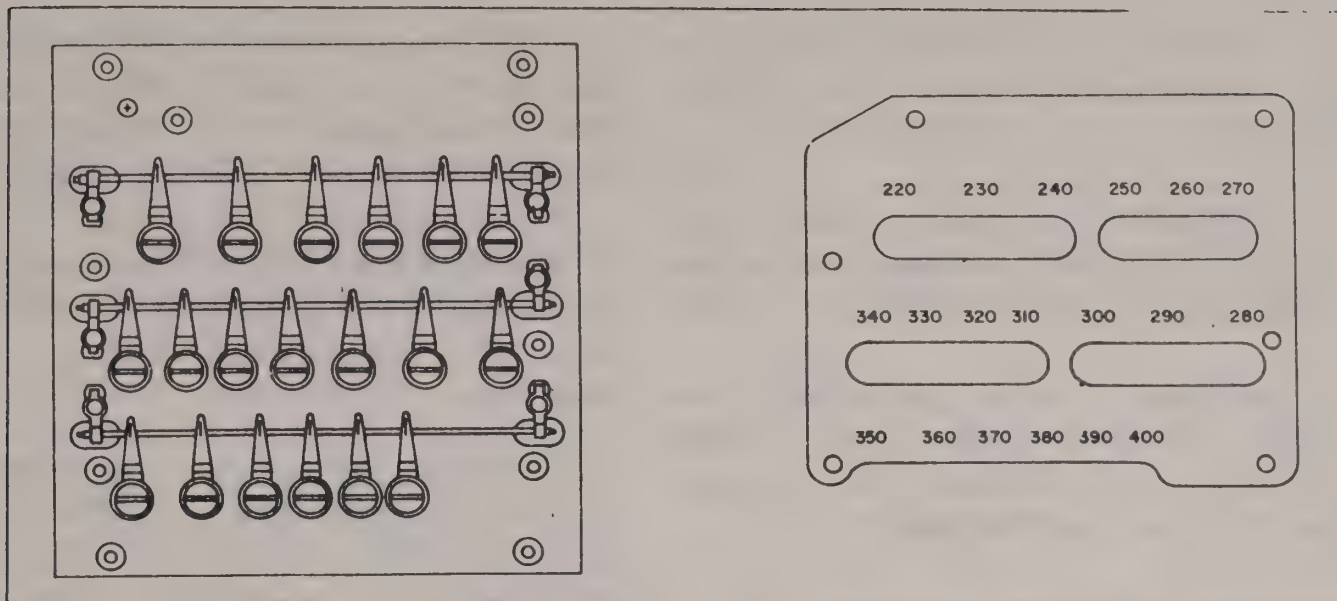


Figure 3-23 Radio Transmitter T-217A/GR, R-1205 Wiper Assembly With Cover Plate Removed.

TABLE 3-7. R-1205 Wiper Adjustment Points

CHANNEL SWITCH SETTINGS (MC)	WIPER NO.	CHANNEL SWITCH SETTINGS (MC)	WIPER NO.
220.2	220	310.2	310
230.2	230	320.2	320
240.2	240	330.2	330
250.2	250	340.2	340
260.2	260	350.2	350
270.2	270	370.2	370
280.2	280	380.2	380
290.2	290	390.2	390
300.2	300	399.2	400

b. MATERIAL REQUIRED.

(1) Slot Screwdriver.

(2) Dummy Load. See Figure 3-8.

c. PROCEDURE.

(1) Remove the modulator and the transmitter from the mounting rack, remove the transmitter dust cover, and place both units on a work bench.

(2) Pull the interlock switch on the transmitter to its full outward position.

(3) Connect a power cable from the 115 V POWER connector on the modulator to an a-c outlet.

(4) Connect the cable from the large TRANSMITTER jack on the front of the modulator to the large jack on the transmitter.

(5) Connect the dummy load to the small TRANSMITTER jack on the front of the modulator.

(6) Set the transmitter CHANNEL SELECTOR to 1, the METER SELECTOR switch to the S.W.R. position, and the three numbered CHANNEL switches to 220.0 mc on Channel 1.

(7) Disconnect J-601 and then connect a coaxial cable from the driver output to the OMNI. ANT. jack on the transmitter.

(8) Adjust C-610 and C-611 to within 1/8 inch of the stator plates (about 5 turns out). See Figure 3-22.

(9) Disconnect the Servo Amplifier plug P-701.

(10) Set the VOICE-MCW CARRIER ON switch on the modulator to MCW CARRIER ON.

(11) Manually adjust the gear train for maximum panel meter indication. Set the VOICE-MCW CARRIER ON switch to VOICE.

(12) Loosen the coupler between the Servo gear train and the Power Amplifier gear train. (located on the top left side of the P.A. Unit).

(13) Reconnect the Servo Amplifier plug P-701, and allow the system to reposition. Tighten the coupler.

(14) Set the three numbered CHANNEL switches to 399.9 mc, set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON, and adjust C-611 for a maximum panel meter indication. Record reading.

(15) Set the VOICE-MCW CARRIER ON switch to VOICE and set the three numbered CHANNEL switches to 220.2 mc.

(16) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON and observe panel meter reading. If it is not the same as before, adjust C-610 and C-611 for a maximum reading.

#### NOTE

If more than 1/2 turn on either capacitor is needed in the above step, reset plot tank at low end.

(17) Set the VOICE-MCW CARRIER ON switch to VOICE and reconnect J-601 to its original connector.

(18) Remove the dummy load from the modulator and connect the cable from the small TRANSMITTER jack on the modulator to the High Voltage jack on the transmitter.

(19) Connect a coaxial cable from the OMNI ANT jack on the transmitter to the antenna. Set the METER SELECTOR switch on the transmitter to POWER OUTPUT-WATTS, and the METER SELECTOR on the modulator to PA PLATE.

(20) Set the three numbered CHANNEL switches for each of the frequencies given in Table 3-7. Each time a new frequency is set up, set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON and adjust the appropriate R-1205 wiper for a maximum reading on the transmitter panel meter.

(21) Observe the meter on the modulator during the performance of Step (20) above and DO NOT allow the modulator meter reading to exceed 400.

(22) Disconnect the equipment and return it to its original condition.

### 3-12 CRYSTAL FREQUENCY CHECK

#### NOTE

The following procedures may be performed by personnel of the second echelon of maintenance or higher.

#### a. TEST EQUIPMENT REQUIRED.

#### b. MATERIALS REQUIRED.

(1) R-F Cable, RG-62 or equivalent.

(2) Connector (one), UG-260, FSN 5935-173-5895.

(3) Dummy Load. See Figure 3-8.

#### c. PROCEDURE.

(1) Remove the modulator and the transmitter from the mounting rack, remove the transmitter dust cover, and place both units on a work bench.

(2) Pull the interlock switch on the transmitter to its full outward position.

(3) Connect a power cable from the 115 V POWER connector on the modulator to an a-c outlet.

(4) Connect the cable from the large TRANSMITTER jack on the front of the modulator to the large jack on the transmitter.

(5) Connect the dummy load to the small TRANSMITTER jack on the front of the modulator.

(6) Connect a coaxial cable from the OMNI. ANT. jack on the transmitter to an antenna.

REQUIRED	SIGNIFICANT PARAMETERS	EXAMPLES (Listed In Order of Preference)
Frequency Counter	Range: thru 42 Mc; Accuracy: $\pm 50$ cps at 40 Mc; High Input Z.	AN/USM-26 or AN/USM-122

(7) Test the Main Oscillator in the following manner:

(a) Adjust the frequency counter as outlined on page 27 of the AN/USM-26 instruction manual.

(b) Set the CHANNEL SELECTOR on the transmitter to position 1.

(c) Set the three numbered CHANNEL switches to 390.0 mc on Channel 1.

(d) Turn the modulator POWER ON-OFF switch to ON. (Allow 15 minutes warmup).

(e) Remove tube V-302 and connect inner conductor of R-F cable (RG-62) of pin 1 of tube socket XV-302 and connect the other end of the

R-F cable to the signal input of the frequency counter.

(f) Set the gate time on the frequency counter to .1 or 1 second.

(g) Set the VOICE-MCW CARRIER ON switch on the modulator to MCW CARRIER ON and check the frequency on the frequency counter. If the crystal is functioning properly the frequency counter should be counting 41.1111 mc.

(h) Set the VOICE-MCW CARRIER ON switch to VOICE.

(i) Repeat Steps (g) and (h) above for each Indicator Dial setting listed in Table 3-8.

(j) The tolerance of these crystals is .002%.

TABLE 3-8. Frequencies for Main Oscillator Test

INDICATOR DIAL SETTING	R.F. BAND MC.	INJECTION FREQ. MC.	CRYSTAL FREQ. MC.
22	220.0-229.9	200.0	33.3333
23	230.0-239.9	210.0	35.0000
24	240.0-249.9	220.0	36.6666
25	250.0-259.9	230.0	38.3333
26	260.0-269.9	240.0	40.0000
27	270.0-279.9	250.0	41.6666
28	280.0-289.9	260.0	43.3333
29	290.0-299.9	270.0	45.0000
30	300.0-309.9	280.0	31.1111
31	310.0-319.9	290.0	32.2222
32	320.0-329.9	300.0	33.3333
33	330.0-339.9	310.0	34.4444
34	340.0-349.9	320.0	35.5555
35	350.0-359.9	330.0	36.6666
36	360.0-369.9	340.0	37.7777
37	370.0-379.9	350.0	38.8888
38	380.0-389.9	360.0	40.0000
39	390.0-399.9	370.0	41.1111

(k) Replace V-302 in its tube socket.

the sum of the two frequencies (ie. 9 and 0.9 should read 29.9 mc).

(8) Test the 1.0 and 0.1 MC oscillators in the following manner:

(f) Set the VOICE-MCW CARRIER ON switch to VOICE.

(a) Remove tubes V-305 and V-101.

(g) Repeat Steps (c), (d), (e), and (f) for all frequencies between XX1.1 and XX9.9 mc.

(b) Remove tube V-403 and connect inner conductor of the R-F cable (RG-62) to pin 6 of tube socket XV-403.

(c) Set the three numbered CHANNEL switches to XX9.9 mc.

(d) Set the VOICE-MCW CARRIER ON switch to MCW CARRIER ON.

(h) Crystals out of tolerance can be checked against a known good one. If 7. and 0.7 read 26.3 mc and should read 27.7 mc, use (for example) 7.0 and 0.9 and the reading is 27.9 mc, therefore the 0.7 mc crystal is the bad one.

(i) Tolerance of these crystals are both .005%.

(e) The output of the two oscillators are mixed at this point and the frequency counter should read

(9) Disconnect all the equipment and return it to its original condition.

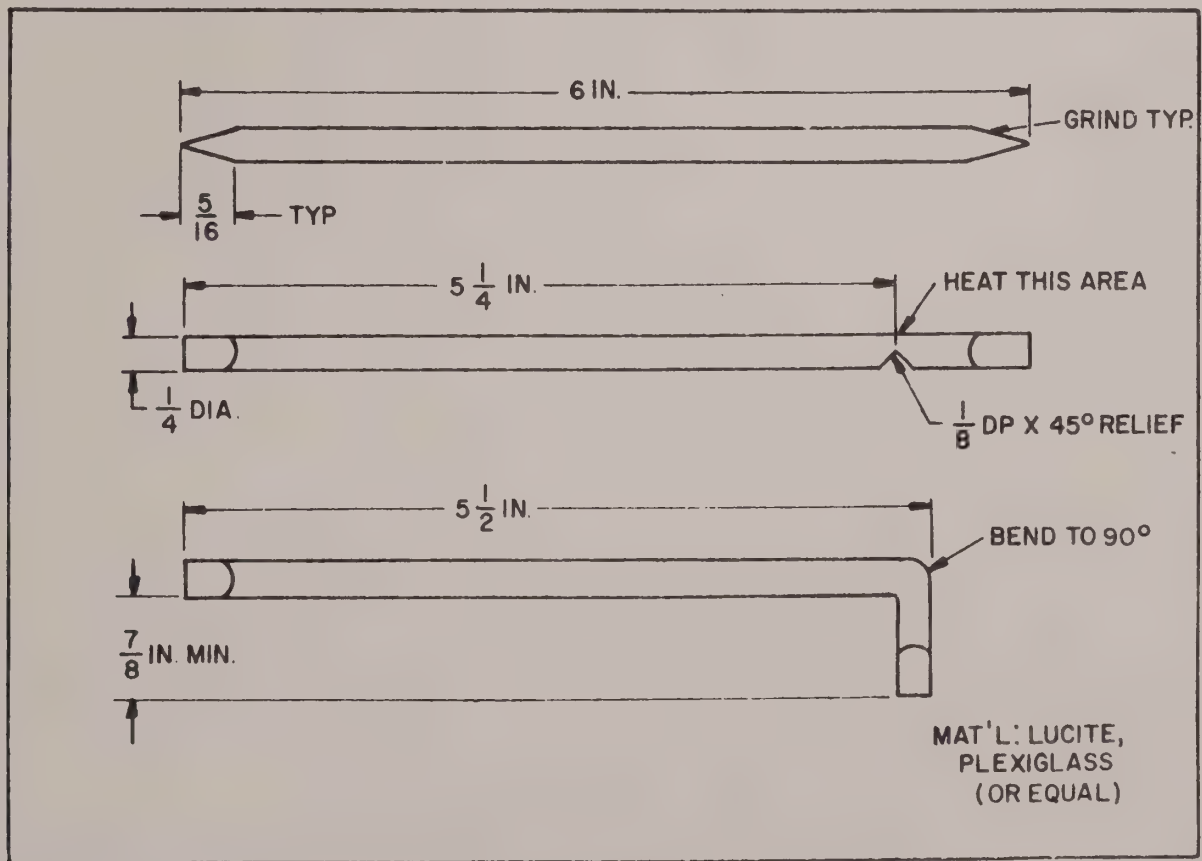


Figure 3-24 Right Angle Insulated Screwdriver Fabrication Details.









